THE

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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H. ALABASTER, GATEHOUSE & CO.,

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ELECTRICAL ENGINEERS AND LEGISLATION.

WE have received from the Secretary of the Institution of Electrical Engineers the important resolutions passed by the Council on 10th inst., and we congratulate both the Institution and Mr. Madgen upon the practical steps they have taken, which we are sure will give general satisfaction to the industry, and go far to dispel the growing feeling among many members of the Institution of dissatisfaction with the inertness of the Council with reference to the serious Legislative restrictions under which electricity supply labours in this country.

It will be seen on perusal of the resolutions, which we published last week, that they set out the facts of the case in a concise, business-like way, and suggest reasonable and practical remedies for the evils under which the business suffers. They point out that the backward condition of the business is due to the restrictive character of the legislation governing the initiation and development of electric power and traction undertakings, especially through the powers of obstruction possessed by the municipalities.

Reference is made to the necessity for areas of supply to be selected on the basis of economic principles and industrial demands, the limitation of districts of supply to the boundaries of local authorities being quite out of keeping with modern developments of distribution over large areas by long-distance transmission. Allusion is naturally made to the relief of congested centres by the promotion of light railways and its assistance in solving the housing question.

The remedies suggested are the amendment of the Electric Lighting Acts; the Tramways Act, 1870; the veto of the local authorities, and the adoption of the recommendations of the Joint Select Committee of Parliament, 1898, on "Electrical Energy, Generating Stations and Supply."

A reform in the procedure for obtaining provisional orders—in order to save time and expense—is naturally put forward, and voices the complaints repeatedly made of the vexatious conditions under which the right to supply electricity under statutory powers are obtained. Of course, the position of the local authorities with reference to their assent to the grant of powers must be urged as most injurious to the progress of the business, not only in the facility it gives for obstruction, but in exacting onerous arrangements prejudicial to the interests alike of undertakers and consumers.

A timely allusion is made to the excellent arrangements made in Switzerland for regulating and promoting the industry, by combined action on the part of the Technical Departments of the Government and the Association of Electrical Engineers, somewhat equivalent to a body in this country if it were composed of members of the Institution, acquainted with both the engineering and commercial branches of the subject, consulting with the Board of Trade

on regulations for dealing with technical matters, and such legislation as may be from time to time necessary.

To obtain, if possible, the sympathy and support of the Government, it is proposed to ask Lord Salisbury to receive a deputation for the purpose of urging the reforms necessary for enabling electrical engineering in this country to increase the prosperity of the industry, and to compete successfully with American, German, and other foreign manufacturers.

We heartily wish success to the efforts of the Committee, and have no doubt that they will receive the enthusiastic support of the electrical interests, and that the Institution of Electrical Engineers will derive considerable strength from thus actively undertaking the steps so necessary for relieving the business from the disabilities under which it has so long suffered.

We have also received a copy of the evidence taken by the Committee, with which we shall deal at another time, as it contains much valuable information and important suggestions for remedying the evils complained of.

The London County Council Electric Supply Bill.

By the decision of the Committee which met on May 1st and 2nd for the consideration of this Bill, a great and real danger from municipal competition to the industry in the distribution of electricity in London has been happily warded off.

Although the Bill had passed a second reading in the House of Commons (personally opposed by Mr. Gerald Balfour) and had been carried on a division, the Committee dealt with the case unprejudiced by the division, in which the Bill had been passed by a small majority, in a meeting of the House which had been scantily attended.

Our readers will only realise its insidious nature when they understand that in one clause it practically would have enabled the London County Council at any time, irrespective of the 42 years' life of the London companies, by securing the unanimity of a majority of the interests, and by agreement with, say, the London Electric Supply Corporation, to have bought up all the rights of that company over seven or eight of the electric lighting areas of London, including Deptford Station, and having thus stepped into the shoes of that company to have become in lieu thereof the second competing undertaker in all the areas in which that company now has power to compete.

This means that such companies as the Westminster, St. James's, the Chelsea and others would, before the termination of the first period of their concession, have found themselves face to face with competition supported by the local rates. Although there may be no record of any authoritative decision that the pioneer companies in London should never be exposed to such unfair competition, our readers who have followed this question must feel convinced that neither Parliament nor the Board of Trade ever intended that the *bonâ fide* investments of the public in electric lighting should be so unfairly jeopardised. The admirable arguments of Mr. Balfour Browne, Mr. Pember, and of Mr. Moon on the second day, as well as the opposition of the Corporation of Westminster on special grounds, were, we are glad to know, in the cause of bare justice to the investor in electric lighting industries, allowed to prevail.

The Workmen's Compensation Act.

Encouraged, doubtless, by the success of former appeals to the House of Lords in relation to the Workmen's Compensation Act, the appellants in the case of Wrigley *v.* Whittaker, which was heard in the Upper House on April 30th, sought to extend the operation of the Act in a new direction. It appeared that the applicant was the widow of a man who met with his death in the following circumstances: He was in the employment of Messrs. Bagley & Wright, a firm of wheelwrights. They entered into a contract with a firm of cotton manufacturers to construct a new fly-wheel in the cotton mill. The applicant's husband met with an injury which caused his death while he was assisting at the erection of the fly-wheel. In these circumstances his widow claimed compensation on the ground that the work at which he was employed was an engineering work, and that the respondents were undertakers. The arbitrator decided in favour of the employers, and his decision was upheld by the Court of Appeal. Mr. Asquith, who argued the case in the House of Lords, submitted that inasmuch as the respondents used a portion of the premises for the purpose of carrying out the work of repairing the fly-wheel, they should be termed occupiers within the meaning of the Compensation Act, and that they were therefore liable. The Lord Chancellor, however, refused to adopt this argument, saying—"The Act cannot be construed as applying to a case such as that before us. This place was not a factory within the meaning of the Act, and an accident, if the Act is to apply, must happen in or about the factory of the employer." It is interesting to consider what would have been the result had the House of Lords adopted the argument put forward on behalf of the appellants. A firm of electrical engineers might send an employé down to the country to erect an installation at a country house, where appliances for preventing accidents would of necessity be scarce. In such a case, if the case under notice had been otherwise decided, an accident happening to the workman might have rendered the employer liable. It is satisfactory to note that the House of Lords has refused to extend the Act in this manner.

Workshop Cost-Keeping.

Speaking generally, we think it is safe to say that a good engineer is rarely a good accountant. The training in the two cases is entirely different. When an engineer has any problem to work out, he will take his slide rule or a scrap of paper, and having arrived at the solution, the slide rule goes back to his pocket, and the paper is tossed aside as of no further use. On the other hand, a man with a clerical or office training would keep a record of any figures or process for future reference.

A combination of the best qualities of the engineer and the accountant is of considerable advantage; is, in fact, indispensable to the managing engineer, who is responsible alike for the commercial and the engineering management of any establishment. As, however, the combination is rare, mechanical aids, such as card systems and a variety of labour-saving forms, are generally adopted in works as a corrective. There is, in short, a kind of workshop ritual to be performed in order to prevent things drifting into chaos. Ritual may be overdone as much in a works as in other spheres, when it becomes a hindrance rather than a help. It requires, therefore, the exercise of no small amount of judgment to determine at what point the "system" becomes unprofitable; when the game ceases to be worth the candle. "Card systems," though looked upon as an American invention, have been used in this country for at least 12 years. These remarks are prompted by a paper on "Co-operation and Mechanical Aids to Workshop Cost-keeping," which was read on the 18th inst. before the North-east Coast Institution of Engineers and Shipbuilders, by R. P. Link.

Whilst there is nothing strikingly novel in the paper itself, anything that tends to impress upon manufacturers and works managers the extreme importance of keeping accurate records of time, materials, and costs is welcome. The

author makes a great point of the cultivation of a feeling of good fellowship between master and man, in order to secure the co-operation of the latter in providing accurate records of what is actually going on in the works. This is the co-operation referred to in the title. Now, estimating is the soul of a business. If the estimating is wrong, it matters not how full of work an establishment may be, its doom is certain; in fact, the greater the turnover the sooner and greater will be the smash. The author of the paper referred to is a great believer in mechanical systems, and refers to time records, calculators, time stamps, costs estimators, automatic book-keepers, wages check deliverers and calculators, and automatic wage-paying machines. "These machines," he says, "when used in combination with one another give such positive results, with such accuracy, that, . . . with such infallible workers mistakes and errors are not possible." A somewhat bold assertion surely! Granting this, however, it is not enough to know the prime, or production costs. The estimator must know what percentage of standing charges to add in order to arrive at the total costs. Now, in a works of any magnitude, in which the amount of work in hand varies considerably from time to time, the percentage of standing charges varies also; and there is no machine nor system which will compute this.

The state of the market is another factor which the estimator has to take into account, for, after all, the estimated price for any work is not so much a question of what it is worth, as what one is likely to get. The superiority of time-recording clocks over the ordinary "board" system is rightly insisted on. Not only should the time of entering and leaving the works be recorded by this means, but also the time of commencing and finishing work on any job. For this means, recording clocks must be placed on every floor, or in every department of a works in a convenient position.

The author describes in detail the various methods of time recording, pointing out the advantages of each, and we quite agree with him that some such system is necessary to prevent "leakage, and save these golden hours and sovereigns," but we must just point out the danger of going to extremes in "systems," until they become ritualistic, and are looked upon as an end rather than a means.

Another paper bearing upon the same subject was read before the same Institution on March 21st, the full title being "Workshop Records: a Review and Comparison of Existing Methods, with Special Reference to the Use of Files and Cards instead of Books." The title is sufficiently comprehensive to indicate the scope of the paper. The card system is described in considerable detail, and deals with records of orders for work *to be* done; of labour or work *done*; of material, raw, in progress, and finished; and of establishment charges. Samples of cards and records are given, and the paper is one that will repay careful study by all managers of works who are not already familiar with the subject.

French Electric Automobiles.—A new type of electric automobile, designed by Milde and manufactured by the Société de l'Electromotion, is described in a recent issue of the *Centralblatt f. Accumulatoren und Elementenkunde*. The carriage is driven by the rear, and is steered by the front, wheels. The battery weighs 550—570 kgs., and has 150 ampere-hours capacity on a 5-hour discharge. It is made up of 42 cells, 24 carried in the front portion and 18 in the rear portion of the vehicle. A landau by the same firm, weighing with its battery 1,700 kgs. (battery alone 550 kgs.), carries six persons and attains a speed of 14·3 kms. per hour on level roads, with an expenditure of energy equal to 59·3 watt-hours per ton-km. For higher speeds the power consumption is proportionately greater, the figures given by the firm being as follows:—Speed 20·5 km. per hour, energy required 60·1 watt-hours per ton-km.; speed 29·2 kms. per hour, energy required 68·4 watt-hours per ton-km. On the bad roads of Paris the energy consumption rose to 80 watt-hours per ton-km.

WALTER'S RÖNTGEN RAY APPARATUS.

In the Electrical Review, Vol. 48, p. 142, we gave a description of the design of an induction coil devised by Dr. Walter, of Hamburg, for use with the Wehnelt electrolytic break, the object being to get the best results from the coil when used to excite a Röntgen ray tube.

Dr. Walter has recently* given a description of the practical construction and method of working his apparatus, of which we give the substance in what follows.

Before installing a Röntgen ray apparatus on this system, it is necessary to ascertain whether connection can be made with a public supply or not. In the latter case the cost of the installation will be much greater than in the former, since a special generator of electricity will have to be obtained. The best generator is a small dynamo driven by a gas engine, or where there is no gas supply, by a petroleum engine. For a military outfit a petroleum motor car is best suited, since the car may be used to carry the apparatus, and the motor of the car used to drive the dynamo.

In a laboratory with a public electric supply, a converter must be used if the supply is alternating, since the Wehnelt breaks only works well with the direct current, and even if the supply is direct a special arrangement may be necessary to reduce the pressure on the mains to a pressure suitable for the coil. This arrangement will be described further on.

The Wehnelt break cannot be used to the best advantage with pressures much higher than 80 volts, and nothing higher than 220 volts is permissible. With the latter

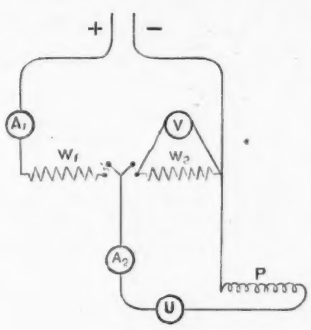

Fig. 1.

pressure the X-ray tube is very quickly used up, and it is therefore always better to reduce the pressure by means of a shunt. This method is very wasteful of electrical energy, but the waste is much less with a Wehnelt break than with the ordinary mechanical break. The shunt arrangement is therefore specially adapted for use with the Wehnelt break, and may be used with advantage even when the pressure is only 110 volts.

The method of connecting up the coil in shunt is shown in fig. 1. The + and − at the top indicate points of connection to the source of electricity; A_1 and A_2 are two amperemeters, V a voltmeter, W_1 and W_2 two resistances, U the break, and P the primary of the induction coil. It is evident that the current from + passes through the amperemeter A_1, which measures the total consumption, then through the resistance W_1, then divides, one part passing through the shunt resistance, W_2, and the other part through the amperemeter A_2, the break U, and the primary coil P, and finally back to the − pole. There are two switch levers where the current divides, by one of which the main circuit can be broken, and by the other, the shunt circuit. The shunt W_2 is cut out when the pressure of the supply is between 50 and 80 volts.

Walter's complete Röntgen ray apparatus is shown in fig. 2. The wires from the source of electricity are shown coming in on the left. The whole of the apparatus is here for convenience shown together, but in actual working the Wehnelt break, shown in the centre of the figure, is placed outside the operating room, in order to get rid of all noise during the working of the coil.

* *Fortschritte auf dem Gebiete der Röntgenstrahlen*, Vol. v., p. 1.

The induction coil with the X-ray tube is set up in a convenient place in the laboratory. The resistance or regulating table on the left is mounted on castors so that it can be readily moved to any place to be within convenient reach of the operator. The room can be completely darkened for screen observations. Over the regulating table is an electric lamp shaded by a green milky screen; and the light may be still further reduced by a "darkening" switch, so that the

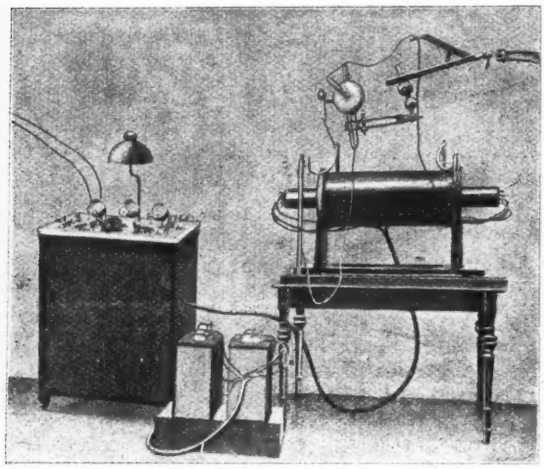

Fig. 2.

objects on the table are only just visible, without diffusing any objectionable illumination through the room. Such a lamp is very convenient in making photographic exposures, since it enables the room to be darkened at any instant during the exposure to ascertain the quality of the tube by means of the screen. The exposure clock is also mounted on the table, and can be inspected at any moment by turning up the lamp.

Proceeding now from these external arrangements to the more detailed construction of the parts of the apparatus, it is, in the first place, advisable that the induction coil should

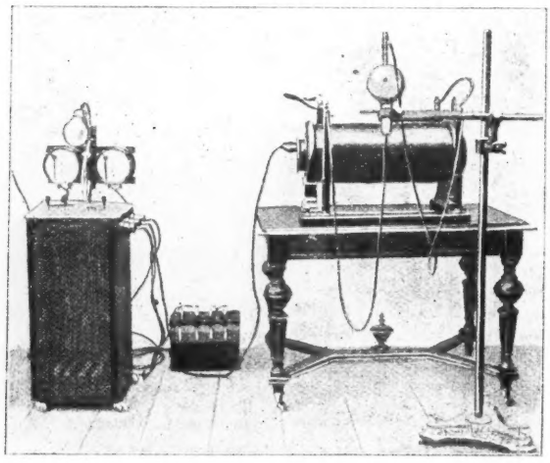

Fig. 3.

be large enough to give sparks at least 40 cm. in length with the Wehnelt break. A larger coil will, of course, have the advantage of having a greater reserve at disposal. Of the greatest importance for the system of apparatus to be described is the construction of the primary coil, the core of which must be wound with several separate layers of wire, the ends of which are connected to the switchboard on the top of the regulating table. Walter calls a coil constructed in this way "a coil with variable self-induction," and such a coil is necessary, because the breaks in the Wehnelt interrupter only take place with regularity when the self-induction of the coil is made greater, the softer the X-ray tube to be excited. Fortunately the spark length with the break used is smaller the greater the self-induction, and changes very little when the load varies. For since the equivalent spark length of an X-ray tube is smaller, the softer the tube is, it follows that, with the above-described method of working, the striking distance of the induction coil always corresponds exactly to that required by the X-ray tube. The mercury break has not this advantage, for with this break the spark length increases when the load increases.

It is also possible with the Wehnelt break to adjust the effect to the tube by varying the length of the platinum pencil, or, what is more convenient in practice, by using a break with several pencils of different lengths ("the multiple Wehnelt"). By changing the length of the pencil, the current strength of the single discharges of the induction coil is changed with very little change in the spark length. In this way it is possible, with the Wehnelt break, to work a tube either with a large number of single discharges of small current strength (short pencil), or with a small number of discharges of large current strength (long pencil). The number of breaks of the Wehnelt may also be increased by reducing the resistance, w_1. Experiment has shown that, in order to avoid heating of the anti-cathode, it is necessary to use shorter pencils with softer tubes. Comparing this result with the remarks above as to the relation that ought to subsist between the self-induction and the softness of the tube, it follows that the greater the self-induction of the primary the shorter should be the length of the pencil of the Wehnelt. The number of pencils in the break should therefore correspond to the number of steps in the self-induction of the primary. In the set of apparatus illustrated in fig. 2 there are six steps of self-induction, and with this it is best to use a Wehnelt with six pencils; in the simpler set of apparatus shown in fig. 3 there are only three steps in the self-induction of the primary, and for this a three-pencil Wehnelt suffices. With the former set (fig. 2) the shunt resistance w_2 is divided into three steps, of which the first, the smallest, is combined with the first and second steps of self-induction, the second with the third and fourth, and the third with the fifth and sixth. With the latter set (fig. 3) only one shunt resistance is provided for all the three steps of self-induction.

The self-induction of the primary is regulated from the regulating table by turning the switch lever, and the best self-induction for any given tube can thus be found in an instant while the tube is working. In the fig. 2 set the length of the pencil of the break is adjusted by a separate handle, a medium length being first selected and gradually changed till the tube works satisfactorily. In the fig. 3 arrangement the operation is simplified by combining beforehand with each step of self-induction the best length of pencil; the complete adjustment is thus made by the movement of one handle.

It is important to remember when adjusting the length of the pencil, that the reduction of the length of the pencil increases the number of breaks per unit of time, and thereby puts a considerably greater load on the tube. To avoid injury to the tube by this adjustment, the series resistance, w_1, should be considerably increased before the length of the pencil is reduced, and then gradually reduced to the required amount.

The resistance, w_1, consists of two parts, one for rough adjustment and the other for fine adjustment. After the best amount of self-induction and length of pencil have been determined, the resistance, w_1, is approximately adjusted by turning the handle which cuts out the large steps; the final adjustment is then made by turning another handle which cuts out small steps in a coil equal to one of the larger steps. The load on the tube can thus be adjusted so that it does not change its quality during a photographic exposure, or an illumination of the screen. If a tube is overloaded, its degree of hardness is reduced, and it is only after a considerable time that it recovers its original quality. As an example of the inconvenience which may arise from a change of hardness in a tube due to over-loading, a tube which is being used in a chest exposure may, in the course of the experiment, be so reduced in hardness as to be useless for the remainder of the exposure.

In conclusion, Walter describes the form of Wehnelt break which he has found after long experience to be the best. It is shown in fig. 4 in the form of a six-pencil break. The cover of the cell containing the acid consists of a thick vulcanite plate, in which are cemented the six porcelain tubes which insulate from the acid the conductors leading to the platinum pencils. These conductors consist of thick lead wires, the lower ends of which are melted on to the platinum wires, while the upper ends are bent twice at right angles and finally soldered to a brass ring capable of being

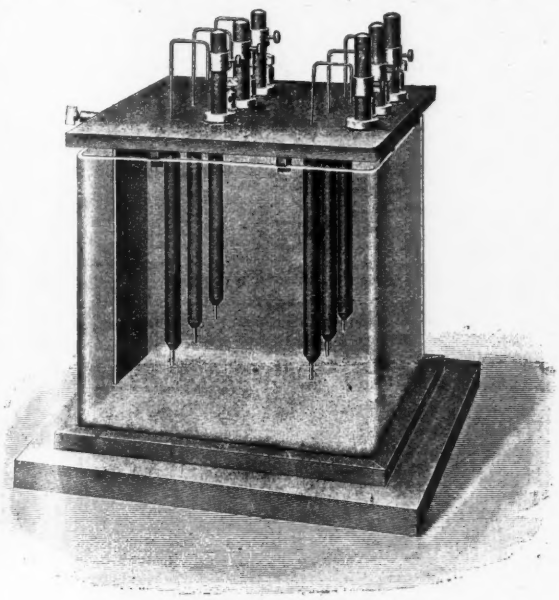

Fig. 4.

raised or lowered on a brass rod and clamped in any position by a set screw. The six holes through the vulcanite lid are just large enough to allow the lead wire to pass, and as no gas can escape through these, the lid is supported a little above the edge of the glass cell by distance pieces to leave space all round for the escape of the gas. Through this space the negative lead plate is inserted at one side of the dish and fitted with a screwed brass terminal.

The advantages of this arrangement are the following :—

1. All brass parts of the apparatus are protected from contact with acid, the acid being in contact with non-corrodible materials only.

2. The length of the platinum pencil can be adjusted readily by moving the brass rings on their rods. Scales of millimetres may be marked on the rods to adjust the pencils to a measured length.

3. Each platinum pencil can be separately removed from the cell for repairs without disturbing the others.

THE GUERNSEY TELEPHONE SYSTEM.

The States of Guernsey are to be congratulated upon the publication of the accounts of their telephone department, which we print in the next column. Confidence is likely to be inspired rather than retarded by the publication of full details. In communicating a sort of summary of these accounts to the *Pall Mall Gazette*, the consulting engineer says, "they show conclusively what may be done in the direction of low rates when a local authority has the wisdom to take in hand its own telephones." They do not, of course, show conclusively anything more than the results at Guernsey so far as recorded. They may show, by inference, the results that might be expected under similar circumstances by a local authority similarly situated. Guernsey is an island of comparatively small dimensions, so far removed from the mainland that, probably, for very many years its telephone service will be of an "insular" character, and need not be considered in connection with any other service. The locality is largely rural; the area is under one authority; there is an entire absence of competition, and the calls are very few in number. If, throughout the United Kingdom, there is any other local authority which has the same conditions to meet, we see no reason why it should not attain similar results. There are, of course, few, if any, localities where such conditions are to be found, and local authorities will be wise to examine carefully and investigate widely before embarking in a competitive undertaking.

Guernsey Telephone Accounts.

Balance-Sheet.

Dr. Liabilities.	£	s.	d.
Capital account—advances from States	19,085	0	0
Reserve account for depreciation ... £1,482 11 9			
Capital sinking fund account ... 269 16 4			
	1,752	8	1
Sundry creditors—On stores account 75 15 11			
On construction account 79 13 2			
On royalty account 34 16 5			
For expenses and generally ... 29 4 6			
	219	10	0
Net profit for year ended December 31st, 1901 ... ... 117 11 2			
Less loss to December 31st, 1900, £300 19s. 6d.; and adjustment account, being calls for one quarter ended December 31st, 1900, not included in revenue account for 1900, £221 15s. 8d. 79 3 10			
	38	7	4
	£21,095	5	5

Cr. Assets.	£	s.	d.
Construction account—viz.:—			
Land and permanent buildings £2,241 18 11			
Works completed and in course of construction 15,292 3 8			
Expenses incurred in connection with above 39 19 9			
	17,574	2	4
Stores on hand 705 9 0			
Tools on hand 133 9 10			
Stationery on hand 31 7 3			
	870	6	1
Office furniture	100	10	2
Sundry debtors 136 8 8			
Sundry debtors for calls, one quarter to December 31st 267 19 6			
	424	8	2
Seventeen Guernsey 3 per cent. States bonds at cost	1,700	0	0
Cash at bankers on deposit account ... 66 0 11			
Ditto on current account 352 15 4			
Cash in hand 7 2 5			
	425	18	8
	£21,095	5	5

Revenue Account.

Dr. Expenditure.	£	s.	d.
Working expenses: Salaries of operators £405 5 11			
Line repairs 110 3 8			
Instrument repairs 98 1 10			
Roof repairs 21 19 8			
Wayleave rentals 2 2 2			
Written off tools account 14 16 7			
	652	9	10
General expenses—Management ... 55 5 5			
Rent, rates, gas, &c. 42 14 8			
Interest on capital 425 2 8			
Post Office royalty 251 4 5			
Commission on public telephone receipts 24 5 11			
Repairs to premises 15 19 9			
Auditors' fees 17 13 9			
Law charges 1 2 6			
	833	10	1
Office expenses—Salaries 128 17 6			
Books and stationery 84 19 9			
Postages 22 0 5			
Written off furniture account ... 5 5 10			
	241	3	6
Depreciation 4 per cent. on amount charged to construction account calculated monthly 628 9 9			
Capital sinking fund account 1 per cent. on the amount charged to construction account, calculated monthly 157 2 5			
	785	12	2
Balance, being net profit for the year	117	11	2
	£2,630	6	9

Cr. Receipts.	£	s.	d.
Revenue receipts—Public telephones	189	9	3
Exchange rentals	1,279	6	4
Private rentals	41	10	0
Sundry rentals	13	3	9
Calls	1,059	18	1
Advertisements	2	2	0
Shifts	1	18	2
Sales	1	6	4
	2,588	13	11
Interest on deposit account	3	10	2
Interest on States bonds	38	2	8
	£2,630	6	9

Statistics to December 31st, 1901.

Description and number of	From July 28 to Dec. 31, 1898.	1899.	1900.	1901.	Inc. for 12 mo.
Subscribers' lines	217	423	606	770	164
Extension lines	10	21	32	41	9
Private lines...	2	5	6	14	8
Public telephones	9	20	26	34	8
Sundry lines	3	3	3	15	12
Service lines...	3	3	5	6	1
Free lines	—	1	1	1	—
Junction lines	7	14	16	22	6
Switchrooms...	3	6	7	8	1
Poles	255	773	916	1,062	146
Standards on roof	9	11	9	9	—
Fixtures to buildings ...	275	742	1,000	1,241	241
Underground cables ...	3	9	11	13	2
Underground cable (distributors)	6	18	22	22	—
	Miles.	Miles.	Miles.	Miles.	
*Metallic circuit wire, overhead	146½	293½	423	581	158
Metallic circuit wire, underground	2½	62¼	132	140½	8½
Metallic circuit, leading-in cables	5¾	9¾	16	18,490y	2,490y
Metallic circuit, from outside wires to subscribers' instruments—	1⅛	2½	4	6¾	2¾
Metallic circuit from cables to switchrooms—	1	1¾	3¼	4,280y	1,600y
Average number of subscribers' and public telephone connections per day (excluding Sunday)	146	449	804	1,170	366
Average number of connections per subscriber and public telephone per day (excluding Sunday)	·9	1·26	1·5	2·1	·6
Total number of subscribers' and public telephone calls in the year—	23,172	143,530	257,138	379,342	122,204
Total number of telegrams, express and ordinary letters telephoned to Post Office—			From August 10th.		
	—	—	363	2,373	2,010
Number of subscribers on No. 1 tariff (£1 10s. per annum, and 1d. per call)	181	383	559	678	119
Number of subscribers on No. 2 tariff (£5 per annum, and 3,200 calls without further payment)	17	21	24	39	15
Number of subscribers on No. 3 tariff (£2 5s. and ½d. per call—	19	19	23	53	30
Employés—Engineer	1	1	1	1	—
Manager	—	—	1	1	—
Clerks	1	1	1	2	1
Inspectors	2	4	4	6	2
Operators (female)	6	12	13	15	2
Operators (male)	2	2	3	3	—
Foremen	2	2	2	2	—
Linesmen, labourers, &c.— ...	12	11	14	13	1 dec.

* The mileage of single wire is double this.

MODEL CONDITIONS FOR ELECTRICAL CONTRACTS.

It is satisfactory to note that a matter of such great importance to the commercial prosperity of the industry as the standardisation of the general conditions to be used in connection with electrical contracts has received the attention of the Council of the Institution of Electrical Engineers. For long that body has seemed to be indifferent to questions affecting the very life of electrical business enterprise, while extremely solicitous about scientific details, important in themselves, but not comparable with the wider interests in jeopardy, due to a large extent to the absence of effective united action.

The appearance of these proposed "model conditions of contract," with which we dealt last week, and the announcement of a recommendation of the Council to memorialise the Prime Minister on another matter of equal importance, with which we deal elsewhere to-day, lead us, however, to hope that the period of *laissez faire* is over, and that the time may come when the Institution will be confidently looked to as the watchful guardian of the interests of the industry.

The first point which attracts the notice of the outside observer is the apparent surprise of the Council that the members should take much interest in such a purely commercial matter as conditions of contracts. They seem to have thought that introduced at the end of one of the closing meetings of the session, they would require little discussion before being accepted as final. For our own part, we are pleased to note the widespread interest in this matter which has necessitated the re-arrangement of the Council's programme, so as to admit of another evening being devoted to their discussion. This interest seems to have been unanticipated by the Council, but will doubtless remind its members of the existence of a general feeling that the Institution as a rule has in the past failed to rise to its opportunities, especially in cases where the commercial interests of its members were imperilled.

The criticisms passed upon the draft clauses by the speakers at the meeting of the Institution at which they were introduced, seem to be fully justified. The principles were admitted to be in many respects admirable, and an advance upon the practice of many consulting engineers, but the drafting was declared to be in many respects unhappy and to bear evidences of adaptation from sets of conditions compiled for other purposes.

Indeed, Mr. Hammond in his opening remarks, not only disclosed his own part in their compilation, but traced their conception back to those forms authorised by the Royal Institute of British Architects which are generally accepted as standard in the building trade. He had proposed that the Council should undertake the work of drafting a standard set of conditions, and the Committee to whom the work had been entrusted had worked on the plan of amending the set he had proposed.

This explanation made it clear why the draft followed so closely the general plan and arrangement which Mr. Hammond has been in the habit of using in his own specifications for many years.

Major-General Webber expressed his sense of the great value of the suggestion made by Mr. Hammond, and remarked that the idea of standard sets of general conditions for embodiment in contracts had been acted upon in the public services for many years. He then criticised several points in detail, pointing out the importance of there being no confusion between the drawings issued with the specification and those which might be finally accepted. He also thought that the meeting specified to take place between the contractor and the engineer *after* the signing of the contract would, in practice, lead to disputes and misunderstandings.

Mr. Raworth regretted that so much had been said as to the inner history of these conditions, for, in their present form, he would personally like to consign them to the waste-paper basket. They savoured too much of the builders' requirements, and needed modifying to make them suitable for electrical contracts. For instance, the word "plant," of which no definition was given in the tender, had several meanings, and might easily be misconstrued. The clause relating to "rejection of inefficient work" was far more suitable for the procedure to be adopted when a wall needed pulling down and rebuilding than when some arrangement had to be arrived at between contractor and purchaser, because a steam consumption guarantee had not been fully complied with. Again, there were engineers and engineers: the independent consultant of high repute, and the resident engineer, who was the servant of the purchaser, but allocated by him to act as his representative in this matter. Would it not be advisable to differentiate in some manner between the two? And as regards patent rights, suppose, as often happened, the engineer specified and insisted upon some particular patent in defiance of the contractor's wishes. If the contractor supplied it, was he to bear the whole responsibility in case of infringement? In his opinion, too, the clause referring to engineers' certificates for payment needed modifying to meet the case of an engineer, who, for any reason, simply took no notice of a request for a certificate on account—did not definitely decline, but simply did nothing. He had known a case where some contractors were kept out of a large sum of money for a long period through such action.

Mr. Jeckell, of Coventry, who followed, spoke from the standpoint of the engineer whose duty it was to draw up the specification. He reminded the Institution of the difficulty which sometimes existed to keep the contractor up to time, and also that the general practice of public bodies to invite tenders by advertisement rendered it necessary for the purchaser to be able to defend his interests against possible undesirable contractors. He preferred that the engineer should have in his own hands the final decision as to quality of material, rather than that it should be possible to refer this to arbitration.

Another direction in which he thought the draft might be advantageously modified, was in providing that all appeals to arbitration were to be made at the end of the period of maintenance, and should not interfere with the progress of the work, or the date of completion defined in the contract.

The most telling indictment against the phraseology employed in the draft was commenced by Mr. Nisbett, who only reached Clause 20 when it was decided to postpone the discussion.

Speaking as a contractor, he stated that he considered this to be the most important work the Institution had undertaken for some time. He thought that Clause 8, stating that the purchaser would not be responsible for the reimbursement to the tenderers of any sums expended by them in the preparation of their offers, should be modified to permit of this being done in the event of the contract not being let. He referred to the notorious case of a town in Ireland where offers were invited on three separate occasions, and tenderers had been put to great unnecessary expense.

The refund of the deposit of the unsuccessful tenderers should take place within a definite period, say, one month of the award of the contract, and a clause should be inserted stating that the tender was only binding on the tenderer for a period of one month.

Mr. Nisbett went on to point out the need for limiting the responsibility of the sureties under the contract to the actual time during which the work was being carried out, and referred to the difficult position in which a contractor was placed who was informed that the contract had been awarded to him *subject to the approval of the Local Government Board.* What was to happen if this was not obtained? Supposing the contractor did nothing but await the formal decision, and this were delayed until the prices of raw materials had advanced far above the prices at which they were included in the tender; should not the purchaser bear some share of the loss? If not, in what position would the contractor be placed who, relying upon the necessary consent being given, bought the raw materials, only to find that the order would not be placed after all? He suggested a clause stating that the contractor should be reimbursed any difference in the cost of raw materials which might occur between the date of the tender and the date of the engineer's definite instructions to put the work in hand.

Clause 18, dealing with the engineer's powers to demand that apparatus specified to be "of an approved type" should meet his approval. Take the case of a contractor who sends in with his tender a drawing of a type of, say, street box costing £2, and the engineer, after the price has been settled and the contract made, demands another type of street box costing £15. What is the contractor to do? By the clause as worded, he is bound to supply it. It would, therefore, be advisable to limit the engineer's discretion to detailed modifications in the types of apparatus of which drawings were submitted.

Mr. Nisbett closed this section of his remarks by commenting upon the difficulty of a contractor being responsible for infringement of patent rights which consisted of the manner in which apparatus was used, and not the apparatus itself.

CORRESPONDENCE.

Electric Wiring Methods of To-day; with Special Reference to Conduit Systems.

I gather from Mr. Bathurst's letter that my comments on his article do not meet with his unqualified approval. Although he may "fail to find any direct mention of a company or firm" in his article, the inference to be drawn from his remarks so clearly indicates that they were directed against the Simplex conduit system and other systems employing rolled steel tube, that one would have thought the more correct course would have been for him to admit it.

I may, perhaps, be excused for not at once acknowledging Mr. Bathurst's new departure of a "special quality steel tube," with its all-proof enamel and "knock-out box," as representing "better practice" in conduit wiring.

"Armorduct," the name Mr. Bathurst tells us *he* has given to the material which is to "keep a distinction between the cheap type conduit at present favoured and gas piping," is itself a gas pipe, and it may be of interest to its present inventor to learn something of its previous history.

It was submitted to me over two years ago by a gentleman from America, under the same name, "Armorduct," which *he* claimed to have given to it, and he offered to sell me at a high figure the "special process" he possessed for preparing and enamelling an ordinary gas tube to make it suitable for electric wiring work. I examined various samples of this "Armorduct," but did not find that it was in any way superior to a rimered and rodded gas tube, such as can be procured in this country from certain of the gas tube manufacturers. Further, I had the varnish analysed, and did not find it to contain other than ordinary ingredients. I presume that the £ s. d. represented by the "price but little higher" in the original article, goes to pay for the "special process" or glorification of the gas tube.

It would, perhaps, be wiser to decline Mr. Bathurst's invitation to discuss with him the *pros* and *cons* of conduit wiring systems, as the subject has been much debated and argued upon in the past to little or no purpose, and to leave the decision of what is to be the final system to the test of time and experience, as those systems will survive which fulfil most efficiently the majority of the requirements of conduit wiring work, at the lowest cost.

Mr. Bathurst, in his letter of the 25th ult., kindly refers to the "success" of the system of wiring in which I am interested. This, however, is not attributable to the cause he suggests, and his information on this point is somewhat at fault. The privilege of using your "Correspondence" columns must not be abused for purposes of advertising the merits of the Simplex conduit system, but Mr. Bathurst may be referred for fuller information as to the reasons for the success of the system to the company's advertisements, which have appeared in their allotted place in the Electrical Review during the last four years.

L. M. Waterhouse,
Simplex Steel Conduit Company.

London, E.C.,
April 30th, 1902.

I note that the representative of the "Simplex" Company still seems to be taking my criticism of the economic utility of "close-joint" and other "cheap" forms of conduit, too directly to himself.

Although I am indebted to your correspondent for the little history he gives of "Armorduct," I am prepared to differ from him, and think that under the more English guise in which I shall present the material, many contractors and engineers may encourage its use. So long as it is found only *equal* to a "rimered and rodded gas tube" there are many who will adopt such a class of tube by preference. Let us then have the name as a means of distinction.

I had no wish to make claim to being the sole inventor, manufacturer, originator or designer—as your advertisement columns might put—but if I understand the electric wiring conditions correctly, I recognise that the time has come to create an interest in a higher grade and more scientifically economic conduit system. It is a somewhat lame reason to refuse to discuss the *pros* and *cons*, because the subject has already been much debated upon to but little purpose, and I venture to suggest that even a little boredom in the matter may be in the nature of a medicine which will eventually alleviate the present uncommercial and blindfolded wiring practice. Didactically, as well as commercially, I venture to think that the salvation of the electrical contractor must

be found in employing a *single* well-insulated conductor rendered "accessible" and well-protected or armoured by a *high grade conduit*, which will also form a neutral potential and uninsulated return conductor. The present competition between gas-piping and electric wiring work by employing two insulated conductors, is tending, commercially, to reduce the quality of the insulated wire, as well as the protection required for it, with consequent lowering of the grade of workmanship, and eventually the reputation of electric wiring work for permanence and safety.

Those who have an eye to *future* developments will continue to recommend the use of a high quality conduit with waterproof and screwed-joint conduit protection, so that if to-day two wires must be drawn therein, the ultimate capacity can be immediately doubled when the principle of an earthed return conductor is admitted in electric lighting practice.

Fred. Bathurst.

I have read with interest the letters of Mr. Bathurst and others in reference to the conduit system of wiring, and I certainly take exception as a practical worker to the statement of Mr. Heaton (Newport, Mon.), that "split tube" can be bent cold to any desired shape. Of course, if one has unlimited time, a special apparatus for heating tubing and every requisite (which are seldom found even on the largest of contract jobs), it might be possible to bend it hot, but when work is being done at a cut price, all these elaborate operations are out of the question; and again, what necessity is there for any extraordinary bending, when there are so many and varied bends and connections supplied by the different makers?

With reference to Mr. Bathurst's pet tubing, "Armorduct," in what sense is it superior to ordinary tubing, say, Union or Simplex? If he is running a circuit, he will, of course, have to cut his tubes to the required lengths, and will join up with the ordinary shaped sleeve, but what will he do with the edges of tube which he has left bare of insulating material? Again, to be of any use the insulation will of necessity thicken the gauge of the tube and reduce the bore, and that will necessitate an increase in diameter, which is a decided inconvenience.

But to prove that ordinary tubing meets all requirements I may say that Messrs. Winter & Co., electrical engineers, Bristol, have now nearly completed the lighting and power installation at Lennard's Buildings, Queen's Road, Clifton, comprising about 1,400 incandescent and nine arc lamps, the whole, with the exception of switch points, being run in union split and barrel tubing (Mr. Leathwood, of Anerley, London, has carried the job through as foreman, and I have had the pleasure of being first hand under him) without developing any faults whatever through the whole job, the corporation test coming out at nearly a megohm, R to earth, over the whole installation, and if this can be done on a large job with uninsulated tube, why "fake" up the same class of material with so-called insulation?

Robert E. Joy.

Bristol.

Consulting Engineering as a Profession.

I have read with interest the letter from "Perplexed" in your last issue. They can surely find room for him in some of the private electrical colleges, and when his course is complete, he need not take a long holiday. No: the fees of these institutions are so large, they must find their way into someone's banking account. The central stations where past students hold appointments coincide strangely with those where a few consulting engineers remind the electrical committees occasionally that it is their agreement with them that they have the appointing of all the technical officials.

Let "Perplexed" make a few more inquiries, and he may discover what may be justly termed the "Royal Road" to become an electrical engineer. Besides, he need feel no anxiety; when his turn comes there will still be vacant offices in Victoria Street; while the wants of the provinces are in no way supplied.

R. Hamilton.

London, *May 5th*, 1902.

Electrical Trade in Australia.

As one of the largest representatives of British electrical manufacturers in this country, I would like to give you some explanation of the enclosed paragraph which appeared in the ELECTRICAL REVIEW. I maintain that the representatives of British firms are doing their best in the electrical trade out here in Australia, but so far as the contract under review is concerned, the local agents had absolutely no control over the order for the tramway machinery for the New South Wales Government. The Chief Commissioner of the New South Wales Government was commissioned to go to England and America to place the order for this machinery.

So far as I can ascertain, he did not consider that any British manufacturer was in a position to supply the goods required; he therefore placed the whole of the orders with the General Electric Company of America, even giving them the orders for the boilers, which they had eventually to purchase from Babcock & Wilcox, of Glasgow, without consulting anyone or calling tenders.

I maintain that certain British manufacturers are every bit as capable of building the machines required for the Sydney Tramways as the General Electric Company, of America. The engines for this plant are being supplied by the Allis Company; the Chief Commissioner gave the order for these engines, as he did for the whole of the plant, without any competition at all.

The excuse for giving the order to the Allis Company was that no British manufacturer could build engines of the size required or in the time; that this statement is absurd I think you will admit, considering that engine builders on the Clyde and other parts of Great Britain are continually building engines from 10,000 H.P. upwards.

The way this large order was placed in America reflects no credit on anyone concerned. For obvious reasons I do not desire my name disclosed; I therefore simply subscribe myself—

A Britisher.

Melbourne, *March 26th*, 1902.

[The paragraph referred to, which appeared in our issue of February 7th, 1902, contained the details of this contract, quoted from the *Electrical World;* by way of comment we asked whether British manufacturers were doing their best to meet the increasing demand for electrical machinery in Australia. If the facts are as stated by our correspondent, we cannot but regard the situation as highly regrettable. The contrast between the procedure of the New South Wales Government and that of the Corporation of Sydney, when recently inviting tenders for the City Electricity Works plant, is marked, and we trust that the example of the latter may be taken as a guide in future business.—EDS. ELEC. REV.]

Ironclad Armatures.

In one or two recent important tramway specifications I have come across the term "ironclad armature" with regard to tramway motors. Mr. Philip Dawson, in his book on "Electrical Tramways," also mentions the term, but I have not been able to discover what is clearly understood by an "ironclad armature" of a tramway motor. I should esteem it a great favour if you, or any of your readers, would favour me with an explanation of this term.

E. Keith.

Bayswater, W., *May 5th*, 1902.

[The term is a misnomer in this connection; strictly speaking, in an ironclad armature the conductors are embedded and completely enclosed in iron. What is meant, however, in this instance, is merely the ordinary tramway motor armature, which is invariably of the toothed or slotted core type, with *open* slots.—EDS. ELEC. REV.]

The Institution and Electrical Legislation.

The declaration of the Institution of Electrical Engineers on the subject of electrical legislation, whilst sounding a note by no means uncertain, ought to please both sides.

It is moderate both in tone and in statement, and it presents the issue so clearly, that those who like it not may obtain satisfaction by exercising their skill with the sling and stone to their heart's content.

I have never yet heard a municipaliser, not even our jovial friend Mr. Pearson, of Bristol, attempt to dispute the proposition that the electrical industry in England has been manacled by the two odious Acts of 1870 and 1882. No one can be surprised that municipalities take advantage of those Acts to build a barrier round the plum tree which they have planted, but it is difficult to understand why Englishmen, be they town councillors or otherwise, can attempt to bolster up and maintain an artificial condition which, though momentarily apparently beneficial to a town, is permanently prejudicial to the interests of the community, and particularly to those of the working man.

The great majority of the population of the country is composed of working men, and they feel the effects of economic changes for better or worse sooner and more forcibly than the wealthier minority. But the working man is short-sighted, and he is much impressed with the declaration that the profits of an undertaking are to be secured by the town for his benefit, and are not to be allowed to fall into the lap of the capitalist, just as though "profit" followed business as a matter of course. He is further flattered by the labour clauses inserted in the specification to fill him up with the idea that his interests are being looked after by the City Fathers, every one of whom knows that these clauses have driven more work out of the country than would have sufficed to have raised the standard of wages by 10 to 20 per cent.

Some of these same City Fathers (but not all) know by their intimate acquaintance with the first principles of business that all artificial interferences with trade do, in the long run, produce results nearly opposite to the intention of their authors. Many of these Fathers have lived through (so far as we have gone) the gas, the tramway, the electric light and the electric power and traction periods. These great eras in the development of civilisation by the genius of man have taught us some remarkable lessons.

Gas was unhampered by legislation, and it has been a great success; even to-day investors, whether private or municipal, like it better than electrics, and it does not appear from the results that Corporations have suffered by paying a big price for a big and lively business. The tramway interest was to have been fostered by the 1870 Act, but the Act killed it. The result was disastrous to the Corporations, to the companies and to their customers. Not one of them got what they wanted.

The first Electric Lighting Act was similar to the Tramways Act, but in the meantime the investor had learnt a lesson, so the business could not be killed, for the simple reason that it could not be born.

The amended Act in 1886 eased the situation somewhat, and the electric era commenced; but the evil effect of these Acts will again show themselves very seriously long before we get to the end of 42 years.

Except in those cases where a very large reserve fund may have been built up at the expense of the consumer, increased capital will not be obtainable, and the business will languish, the local authority may buy, but it will not get much for its money. Of course, a bride is always beautiful, but this one will require a very thick veil.

Some people are disposed to argue this question on the ground of municipal competition with private trade; that side of the question has no attraction to me. I am quite willing to take on the competition on the lines laid down by Mr. Pearson—that is to say, on a fair field, with no favour. Mr. Pearson's theory is, that under these conditions, cheap municipal capital will gain the day, but under those same conditions I can get money on as good terms as Mr. Pearson, and can provide the undertaking with much better management.

I have the honour to enjoy the intimate friendship of a large number of aldermen and councillors, most of them ardent municipalisers, but their eyes are wide open to the difficulties of their position. Their intention is to run a business on business lines for the benefit of the ratepayers, that is the theory; but, in practice, they find that everyone wants a bit; the working man must have his wages raised, the shopkeeper wants the street improved, the traveller wants more comfort and lower fares, whilst the ratepayer looks out for the promised dividend. The result is, that the "business" theory breaks down.

The next step is an easy one—why not have trams free to all and pension the conductors? It sounds startling, but it is logical enough when once the "business" theory has been assassinated. Of course, we don't like to talk of assassination in this free and law-abiding country of England, but it is not half so uncomfortable for the subject as the process of mutilation and emasculation under which this rising industry, the light of the 20th century, now legally writhes.

Our multitudinous municipalisers seem quite incapable of taking into account the effect of the time element. Every new great invention of general application produces a great increase of wealth, either by increasing production with less labour, or by saving labour and material in conducting a necessary service to the community.

Electric tramways do this and more, in addition to the various items of direct saving, they save the time and shoe leather of the artisan, and of every man and woman to whom time is money, and they raise the radius of the zone around a large town in which land attains a special value.

We, as a community, have been looking at this job a long time, and the bit we have accomplished has been well done, but in the meantime our American cousins have made so much out of the few years' start they have got on us that they can afford to bring their dollars here and buy up our ships and railways. The one thing that a municipality can do well is to wait, the idea of taking the tide at the flow does not suit them; they want to be quite sure that it has touched the top, so they go on waiting till the ebb sets in.

This is the explanation of our present position which is to drag at the heels of other nations—it is not because the spirit of the nation is dead, but because we have put ourselves in legal irons, which must rot off before we shall get free—the simple remedy of getting the smith that made them to chop off them again would be too plain a cure for a legislative assembly which cannot do anything without a precedent.

John Raworth.

The Influence of Tariffs on Electrical Supply.

There is a certain form of diversion much in vogue among the *jeunesse dorée* of the British race consisting of the burning in effigy (on November 5th) the counterfeit presentment of a certain historical personage, the main peculiarity of this presentment being that it shall be as counterfeit as possible.

Your contributor, Mr. Dick, has been indulging in this pastime, in a controversial sense, with regard to my article on the above subject.

I have carefully re-read this article and can find no suggestion direct or inferential that:—

1. The method of charging is the *only* thing that influences the load factor; or

2. That all stations, having an equal output and the same method of charging, ought to have the same load factor.

Having misrepresented me thus with studied inaccuracy, Mr. Dick proceeds to exhibit in detail and at length, his obvious failure to understand the very simple proposition enunciated by me, viz., that by classifying stations according to the presence or absence of a certain peculiarity, the influence of that peculiarity evidences itself in the mean result, other peculiarities not taken into consideration in the classification automatically cancelling out.

It was in order to meet such possible objections as Mr. Dick's, as well as to show the comparative unimportance of secondary classification, that my tables were arranged as they appeared.

This disposes of Mr. Dick's strictures regarding my results.

As to the suggestion that the maximum demand system *should have* a tendency to the improvement of the load factor, with this I quite agree. I submit, however, that, in practice, this result is not, as a rule, noticeable.

This may be due to the fact that it is frequently applied in an emasculated form, as in cases where a separate tariff is adopted for motor users, &c.; and also to the diffi-

culty of properly explaining the system to the consumer. Whatever the cause, however, the evidence I have put forward show that, in the large majority of cases, the maximum demand system has failed to produce any material influence on the load factor.

Mr. Dick follows his condemnation of my method by quoting certain mysterious results of his own, which, I fancy, he has already hinted at elsewhere. It is a pity he has not seen fit to publish his data, as—if they should prove his contention—it would be conferring a considerable benefit upon the electric supply industry; for, after all, what most of us are aiming at in this connection is to ascertain what really is the best tariff system for all but very exceptional cases.

Mr. Dick has nothing but assertions to put forward in his condemnation of the time switch system, and as they are unsupported by argument, I need not consider them. I would, however, protest against another little vicarious *sauto-da-fé* indulged in by my critic, in which he accuses me of holding the opinion that the flat rate is all that can be desired. It is so obvious from Mr. Dick's remarks in the same paragraph that this is not my opinion, that a protest only is necessary.

I am truly sorry that Mr. Dick should have adopted tactics of this nature, as they are unsportsmanlike, and one does prefer to hold one's opponent in as great respect as possible in this as in other forms of discussion—there is so much more *kudos* to be gained by knocking him out.

C. Ashmore Baker.

LEGAL.

Heap *v.* Blackpool Tramway Company and Another.

In the Chancery Division of the High Court of Justice on Friday, May 2nd, Mr. Justice Buckley had before him a motion by the Tramway Construction Company, the second defendants, to strike out the statement of claim to stay the action on various grounds.

Mr. Astbury, K.C., who appeared in support of the motion, said the Blackpool Tramway Company were the successors of a company running horse tramways at Blackpool, and the new company was formed for the purpose of running electric tramways. They made arrangements under which they would buy up the whole of the shares and property of the whole company, electrify the roads, and put on new trams. The plaintiffs were the trustees for the debenture holders of the new company, the debentures being secured by a trust deed executed by the first defendants. The Construction Company were employed by the first defendants under certain agreements for the purpose of electrifying the tramway. By an agreement of June 19th, 1901, and made between the tramway company and the contractors, the contractors were to be entitled to purchase about three-fourths of the ordinary and three-fourths of the preference shares, and the new company was to issue £150,000 debentures, 100,000 preference shares, and 150,000 ordinary shares for the purpose of buying up the old company. The capital of the old company was 45,000 ordinary shares, 40,000 preference shares, and 40,000 first and 12,000 second debentures. The contractors were to have the debentures as fully paid up, pass them on to the public, and so obtain a sufficient amount for constructing and equipping the line, and the money as and when received was to be paid into the account of the plaintiffs. The statement of claim alleged that the debentures had to a large extent been placed with the public, but the Construction Company refused to pay the proceeds over to the defendants, and this action was brought for specific performance of the contract. He asked that the action might be stayed on the ground that another action prior in date by the Tramway Company against the Construction Company had been substituted, raising precisely the same questions, that the statement of claim disclosed no cause of action, and might prejudice the first action, and that a third action was also pending. The difficulty had arisen through the applicants leasing the contract to one named Rutherford, who was not carrying it out, and the Construction Company were bringing an action against him. The learned counsel asked his Lordship if he would not stay the action to direct it to come on with the action by the Tramway Company against his clients.

Mr. Buckmaster, K.C., for the plaintiffs, said he would not object to the actions being brought together if a proper application were made.

Mr. Justice Buckley said he could not make the order asked. The motion would be dismissed, the costs to be the respondent's in any event.

Boddington *v.* Clayton Engineering and Electric Construction Company.

Last Friday, in the Chancery Division, Mr. Justice Farwell heard the case of Boddington *v.* Clayton Engineering and Electric Construction Company. Mr. C. H. Sargant, for the plaintiff, moved for the continuance of the appointment of a receiver and manager made on an interim order over that day. The debentures in issue for £20,000 had matured, and plaintiff held £3,000. Parties to the other series of debentures had been joined since the interim order was made. It was a large electrical and engineering business, and there was a substantial goodwill. His Lordship made the appointment asked for, limiting the manager's acting to six months.

National Electric Free Wiring Company *v.* Canterbury Corporation.

Plaintiffs, last week at Canterbury County Court, claimed £15 damages from the Corporation, who removed an installation from the "Rose Tap." It seems that a man named Wildman, whilst tenant of the "Rose Tap," in Rose Lane, gave an order for the National Wiring Company to put in an installation to his house, and entered into the usual agreement, which was also signed by the landlord, who consented to the installation being put in. Wildman gave up possession of the premises at the end of December last, and the incoming tenant refused to enter into the agreement, but had another installation put in, and called upon the Corporation to supply him with energy. The Corporation being compelled by their provisional order to supply energy, did so, and having requested the Wiring Company to take away their installation, and the company refusing, the Corporation removed it with a view to preventing the liability of the minimum rental reserved under Wildman's agreement being cast upon them, and held it at the risk of the Wiring Company. It was this removal, without the consent of the Wiring Company, that was the *raison d'être* of the action. The company also claimed the minimum rental due under their agreement with Wildman.

His Honour thought the Corporation had made a mistake. He gave judgment for the plaintiffs for the amount claimed for damages; then came the question as to the claim for the rent. He did not consider the defendants were responsible if they could not recover it from the consumer, who was the person liable to pay. He was not satisfied that Wildman was unable to pay up to December 31st last, therefore it appeared to him that Wildman was still liable to pay up to that time £1 2s. less the 7s. 11d. he paid for the time he was in occupation. He did not think the Corporation were called upon to sue Wildman except at the request of, and on the indemnity of the Wiring Company. He would give judgment that the Corporation pay the minimum rent for the last quarter from January 1st to March 31st, 5s. 6d., thus making a total of damages £15 and rent 5s. 6d.

Mr. Norman Craig, for the Corporation, asked leave to appeal, which was immediately granted.

Ratepayers' Action Against Hastings Corporation—The Electric Tramways Scheme.

In the Chancery Division of the High Court of Justice on Saturday, Mr. Justice Buckley had before him the case of the Attorney-General and John Bray, *v.* The Mayor and Corporation of Hastings. The action was brought for a declaration from an agreement purporting to be made between the Hastings Tramways Company, incorporated by the Hastings Tramways Act of 1900, of the first part, the defendants of the second part, and W. M. Murphy of the third part, dated June 1st, 1901, as illegal and *ultra vires*. An injunction was also sought by plaintiffs to restrain the defendants from carrying into effect the said agreement whereby the plaintiff was liable to be injured through the alleged legal expenditure of the money paid to the defendants in respect of rates. Defendants generally denied plaintiffs' allegations. Mr. Astbury, K.C., and Mr. Askwith appeared for the plaintiffs, and defendants were represented by Mr. H. Terrell, K.C., and Mr. MacSwinney.

The statement of claim set forth that the plaintiff is a ratepayer in respect of a large number of houses in Hastings, and is also an alderman of the borough. At a meeting of the Borough Council in October, 1899, at which the plaintiff was present as a member, the Tramway Committee brought up a report dealing with the intention of Mr. Murphy to promote a Bill authorising the construction of electric tramways in the borough, in the next Parliamentary session, and his application for the support of the Corporation. The Committee recommended that the Council should support the Bill on terms, one of which was that the Corporation should enter into an agreement to consent to an application by the promoters to obtain powers for the construction of a tramway between the eastern terminus of the proposed Bexhill and St. Leonard's Light Railway line, and the Albert Memorial, whenever the Corporation deemed it expedient to give such consent on terms. The promoters were to pay in respect of the tramway a wayleave of £325 per mile per annum for the first five years, and of £400 per mile afterwards, and the particular system was to be such as the Corporation should determine. The report of the Council in Committee was adopted, and the town clerk was instructed to take the necessary steps for giving effect to the arrangements. The Bill was brought forward in Parliament, and was opposed by the plaintiff and other ratepayers, but it finally became law, under the title of the Hastings Tramway Act, 1900. The Act contained no reference to the terms upon which the Council in Committee reported in favour of the promotion of the Bill, although an agreement, embodying the terms of the report, was scheduled in the Bill as deposited, and struck out, together with all clauses relating thereto, in accordance with the terms and conditions under which the Council had agreed to support the Bill. The altered conditions were never brought before the Corporation, and never adopted by them, and no opportunity

of discussing it was given the Corporation. In this state of things an agreement between the Corporation, the Hastings, Bexhill and District Light Railway Electric Company, and Mr. Murphy, was executed on April 28th, 1900, in terms similar to the agreement scheduled in the Bill deposited and rejected by Parliament. The agreement of April 28th was never brought before the Corporation, and never adopted by them, and no opportunity of discussing it was given. Plaintiff alleged that it was at a meeting of the Corporation on April, 1901, at which he was present, that they were told for the first time that soon after the rejection of the scheduled agreement in Parliament a similar agreement had been entered into by the Corporation, and the Tramways Committee proposed that their report thereon should be adopted. The Corporation were at once notified that the agreement was illegal and the proceedings of the Corporation illegal, and a motion to that effect was moved by one alderman, supported by the plaintiff, and lost by a small majority. At the same meeting the Corporation adopted the Committee's report by 18 votes to 14. The agreement of June 1st, 1901, which was sought to be set aside as illegal contained clauses as to the widening of streets and the working of the old town tramways. It was said that the terms it contained were not authorised by the Act, and should not be binding upon the ratepayers.

Mr. Astbury, in the course of his opening statement, said the agreement which the Corporation now wanted was one struck out in Committee. They wanted to be able to act as though it were still standing as part of the clause. The learned counsel further submitted that the resolution of April 19th was invalid, because the members of the Council were asking to direct an agreement to be executed which they had never seen or considered. Proceeding, he pointed out that if in 50 years hence the Corporation wanted a tramway down the promenade, and somebody other than Murphy was willing to give them £1,000 per mile, they could not promote a Bill to enable that person to do it. As road authorities they would be bound to call upon Murphy to construct the line on agreed terms. Murphy's terms might be preposterous owing to their circumstances. Their assent, as road authorities, involved a large number of circumstances, which they ought to take into consideration and exercise their discretion upon. All this the Corporation tied up. The Corporation of to-day could not bind the Corporation of 50 years hence as to what steps they would take for effecting a desire to have tramways along the promenade, and what mileage rents ought to be paid.

The further hearing was adjourned.

On Tuesday Mr. H. Terrell, K.C., said that his clients had communicated with the solicitors who acted for both Mr. Murphy and the tramway company, and they said that they had no instructions from either of the parties in the matter, but that they would apply to get instructions. He was also told that neither Mr. Murphy nor the tramway company were prepared in any way to assist the Corporation or the plaintiff, and therefore he (counsel) did not think they would consent to be represented. In these circumstances it was impossible to decide this case in the absence of these parties.

Mr. Astbury said that, having regard to an intimation from his Lordship that they must get the other two parties before the Court, he would ask his Lordship to amend the writ and statement of claim by joining the parties named and allow the case to stand over, with liberty to apply as soon as it was ready for hearing.

His Lordship granted the applicaiion.

PARLIAMENTARY.

The Board of Trade and Electrical Undertakings.—Mr. H. Hobhouse, M.P., has reported to the House of Commons in connection with Group 3 of Railway Bills, that his Committee has agreed to the following special report:—"That the Committee have had their attention drawn to the fact that it is not the duty of any Government department to examine into and to report upon proposals for electrical undertakings however extensive and important. In view of the rapid development of such undertakings and the novel and possibly dangerous character of some of the proposals, the Committee consider it desirable that in future every Bill containing such proposals should be reported upon by the Board of Trade."

Manchester District Telephone Board.—It is understood that this Bill, which has been frequently mentioned in our columns, is to be withdrawn.

Whitechapel and Bow Railway.—This Bill was before the Unopposed Committee of the House of Commons on Wednesday last week, and was ordered to be reported to the House.

Tramway Bills.—A Committee, consisting of Mr. Compton Rickett, Sir H. Bullard, Mr. Freeman Thomas and Mr. Claude Lowther, will consider the following Bills:—Croydon and District Electric Tramways, London United Tramways and North and South Shields Electric Railway.

London, Tilbury & Southend Railway Bill.—The Select Committee of the House of Commons, presided over by Mr. H. Hobhouse, for four days had this Bill under consideration. Various objects are sought under the Bill. Clause 28 empowers the company at any time to work any part of the line by electrical power, and to take and hold land at Little Ilford for the purpose of a generating station. Mr. Littler, K.C., who appeared for the promoters, said that while the company asked for powers to enable them to use electricity as the motive power for the whole line, they only proposed to proceed tentatively with the exercise of those powers, and particularly they had in view their connection with the Metropolitan District Railway system by means of the Whitechapel & Bow line, which the company hoped to open in June. The District Railway would probably be worked by electricity within two years, and it was desirable to work the Whitechapel & Bow line in connection with it.

All the opposition to the Bill was confined to matters apart from the electricity proposals, except in the case of Mr. Benning, who objected to the compulsory sale of the land on the western side of the River Roden, required for the erection of the generating station. The Committee found that the part of the Bill referring to electrical traction and the purchase of land for a generating station was proved.

North Metropolitan Tramways.—This Bill was before a Committee of the House of Commons, presided over by Mr. H. Hobhouse, on Thursday and Friday last week. The Bill is promoted to empower the company to work their line between Wood Green and Finsbury Park and from Finsbury Park to Edmonton in the County of Middlesex, by electricity.

Mr. Wheeler, K.C., and Mr. Munro were for the promoters, and Mr. Earle appeared for the Middlesex County Council.

Mr. Wheeler, K.C., in opening the case, said there was no opposition to the preamble. The lines for which they asked powers belonged to the company, although all those lines which were within the County of London were the property of the L.C.C., and were leased by that body to the company. The lines they now asked power to electrify were not in the County of London, but were in the County of Middlesex. When the Bill was in the House of Commons the question of an all-night service was raised, and it was urged that the Committee should make some inquiry into this. He might say that the company had run an all-night service, and had incurred a heavy loss, and he asked that the Committee should impose no such conditions upon the promoters.

Replying to the Chairman, Mr. Wheeler said the question of working cars by electric power within the County of London was a matter for the L.C.C.

Mr. E. Hammond, manager of the Tramways Company, was called in support of the Bill, and said that if the Bill was passed, the lines concerned were 8½ miles in length. The local authorities through which the line ran were in favour of the tramways being electrified. With regard to the question of an all-night service, at no time had the cars paid for the cost of running.

The Committee then found the preamble proved, and the Chairman said: We are not prepared to make any recommendation to the House in regard to times of car service. We feel sure that the company in their own interest will do all that is reasonable for the benefit of the district they serve, and that the L.C.C. will look after the requirements of the public.

Mr. Wheeler submitted a proposal which would enable the local authority of Wood Green, which had obtained from the Board of Trade a provisional order empowering it to supply electrical energy, to provide the electric traction which would be required under the Bill. He assured the Committee that the provisional order was not a bogus one, and it was hoped that in due course it would be confirmed by Parliament.

The Chairman said the Middlesex Council, who were the road authorities, contemplated working their tramways in connection with the North Metropolitan Company, and would therefore use electricity. Under these circumstances, the Committee could not agree to bring in another authority with a veto as to the supply of electricity. If Wood Green wished to have this power, it should appear in the House of Lords when the Bill reached it and ask for it.

The clauses having been adjusted, the Bill was ordered to be reported to the House for third reading.

Manchester Corporation Tramways.—This Bill came as an unopposed measure before Earl Morley's Committee of the House of Lords on Thursday last week. The Bill has already passed the House of Commons, and formal proof of the preamble having been given, it was ordered to be reported to the House of Lords for third reading.

Cornwall Electric Power Bill.—This Bill came before Earl Morley's Committee of the House of Lords on Unopposed Bills on Thursday last week, and was ordered to be reported to the House of Lords for third reading.

Brighton and Rottingdean Seashore Electric Tramway.—This Bill came before Lord Morley's Committee of the House of Lords on Unopposed Bills on Thursday last week, and formal proof of the preamble having been given, it was ordered to be reported to the House for third reading.

Metropolitan Railway Bill.—The Corporation of London have withdrawn their opposition to this Bill.

Middlesex County Council Tramways.—This Bill, which has passed the House of Commons, came on Tuesday before a Select Committee of the House of Lords, presided over by the Duke of Northumberland. The promoters were represented by Lord R. Cecil, K.C., Mr. Moon, K.C., and Mr. Harper, whilst the petitioners against the Bill were the London United Tramways Company (represented by Mr. Balfour Browne, K.C., Mr. J. D. Fitzgerald, K.C., and Mr. Coward, K.C.), the Twickenham, Heston and Isleworth Urban District Council, the Chiswick Urban District Council, the Acton Urban District Council, the Hendon Urban District Council, and the Tottenham Urban District Council. The object of the Bill is to make the County Council a local authority within the meaning of the Tramways Act, and when it was before the House of Commons Committee a clause was inserted making it clear that the powers of purchase with regard to tramways shall only be exercised with the consent in writing of the local authority of the district in which the tramways proposed to be purchased are situate.

Lord R. Cecil, in opening the case, said the general nature of the proposal was that the County Council should, in certain circumstances, and with certain safeguards, be allowed to purchase tramways in the county by agreement with local authorities. The growth of the population of Middlesex made it most important that travelling facilities of all kinds should be given for people going to and from London, and many schemes of tramways and light railways had been promoted going through the districts of various local authorities. The County Council wished to be admitted as the general local authority within the county.

Mr. Bigwood, M.P., and Sir Alex. Binnie gave evidence in support of the proposals of the Bill, and the Committee adjourned.

Leicester Corporation Bill.—Opposition having been withdrawn, the Bill has accordingly been taken from the list for consideration by a Select Committee. The Bill empowers the Corporation to electrify the tramways taken over from the tramway company, and to construct additional lines.

North and South Shields Electric Railway.—On Friday the Court of Referees of the House of Commons considered the application of the Cyclists' Touring Club to be heard in opposition to the North and South Shields Electric Railway Bill. The ground for the application was that the proposed charge for the carriage of cycles on the railway which will connect North and South Shields was excessive. When the Bill was before the House of Lords Committee, the *locus* was disallowed, and the chairman decided to disallow the *locus* before the House of Commons Committee.

London County Council (Tramways and Improvements) Bill.—On Friday the Court of Referees of the House of Commons considered applications for *locus standi* before the Committee inquiring into the above Bill with respect to the proposal to run tramways along the Thames Embankment. Mr. Blennerhassett, K.C., appeared for the Corporation of the City of Westminster, and said that as the London County Council was the road authority for the Thames Embankment the consent of the Westminster local authority was not necessary. He contended, however, that since under the Local Government Act of 1889 there was a provision which would allow of the road being handed over to the local authority for repair and maintenance, he had a right to be heard. He also claimed a *locus standi* under Standing Order 34, which gave the right to those local authorities likely to be injuriously affected by a private Bill. The Chairman decided to disallow the *locus* of all petitioners who were not owners, lessees or occupiers, and left the Committee to decide who should be heard.

London County Council (General Powers) Bill.—After eight days' examination, the Select Committee of the House of Commons, presided over by Mr. F. Cawley, has passed the preamble of the London County Council (General Powers) Bill. The Bill contained a clause empowering the Metropolitan Borough Council of Camberwell to acquire a site compulsorily for an electricity generating station, but this clause was not proceeded with, as the Borough Council did not wish to go further in the matter. The clause enabling local authorities to borrow and expend money for the purpose of wiring and fitting consumers' premises for electric lighting was struck out.

Wigan Corporation Tramways.—This Bill was down for consideration by Lord Pirbright's Committee of the House of Lords on Friday, but as it was intimated that the opposition had been withdrawn, the Bill was referred to the Unopposed Committee.

Birmingham and Midland Tramways.—This Bill should have come before Lord Glenesk's Committee of the House of Lords on Friday last, but there was no appearance of the parties, and presumably opposition is withdrawn. The Bill authorises the Birmingham and Midland Tramways Company to construct additional tramways, and to use mechanical power upon their tramways.

Devonport Tramways.—The omnibus Bill of the Devonport Corporation came before a Select Committee of the House of Lords, presided over by Lord Glenesk, on Friday. An arrangement having been come to with the only opponent, the Committee declared the preamble proved and adjusted the clauses.

Electric Lighting Provisional Orders Bill (No. 6).—This Bill, which originated in the House of Lords, and confirms certain provisional orders granted by the Board of Trade, passed through its first stage on Tuesday. It deals with the following districts:—

Ardsley.—Order granted to the Urban District Council of Ardsley East and West, in the West Riding of Yorkshire.

Barton Regis.—Order granted to the Barton Regis R.D.C.

Blayton.—Order granted to the Blayton U.D.C., who may transfer the order within one year to the County of Durham Electrical Power Distribution Company, Limited.

Chester-le-Street.—Order granted in respect of the township of Chester-le-Street to the County of Durham Electrical Power Distribution Company, Limited.

Church Stretton.—Order granted to the Church Stretton Land Company, Limited, of 18, Adam Street, Strand, W.C.

Lees.—Order granted to the U.D.C. Power is given to transfer the order to any local authority authorised to supply electricity in any district adjacent.

Lower Bebington.—Order granted to the Urban District Council of Lower Bebington, in the county of Chester.

Newburn.—Order granted to the Newcastle and District Electric Lighting Company.

Seghill, Earsdon, and Tynemouth.—Order granted to the Northern Counties Electricity Supply Company, Limited, in respect of the urban districts of Seghill and Earsdon, and so much of the rural district of Tynemouth as is included in the parishes and townships of West Hartford, East Hartford, Bebside, Harton, Seaton, Delawel, and Bunadon, in the county of Northumberland.

Stanley.—Order granted to the U.D.C. of Stanley.

Electric Lighting Provisional Order Bill (No. 5).—The Electric Lighting Provisional Order Bill (No. 5) passed the Examiners in the House of Lords on Tuesday. The Act confirms provisional orders granted by the Board of Trade in respect of the following districts:—

Carnoustie.—Order granted to the Electric Supply Corporation, Limited.

Dumbarton.—Order granted to the Provost, magistrates and councillors of the burgh of Dumbarton.

Glasgow (Kinning Park).—Order granted to the Corporation of Glasgow.

Govan.—Extension Order granted to the Govan Council.

Nairn.—Order granted to the local authority.

St. Andrews.—An order granted in respect of the Royal Burgh of St. Andrews, in the County of Fife, to the Electric Supply Corporation, Limited, Salisbury House, London.

London County Council (Electric Supply) Bill.

The above Bill was before a Select Committee of the House of Commons, presided over by Mr. Cawley, on Wednesday, Thursday and Friday last week. Mr. J. D. Fitzgerald, K.C., Mr. Freeman, K.C., Mr. E. H. Lloyd and Mr. Scott, appeared for the County Council, and the opponents to the Bill were the Council of the City of Westminster, the Metropolitan Electric Supply Company, the London Electric Supply Corporation, the Kensington and Knightsbridge Electric Light Company, the Notting Hill Electric Supply Company, the City of London Electric Light Company, the Central Supply Company, and the Westminster Electric Supply Company.

Mr. Fitzgerald, K.C., who appeared for the County Council, said the Bill was promoted with the main object of removing certain difficulties that had arisen in the way of allowing local authorities the exercise of powers of purchase over electric lighting undertakings. Under the Electric Lighting Act of 1882, undertakings were purchaseable at the expiration of 21 years from the coming in force of the order authorising the undertaking. This, however, was found to be too short a period to induce the public to invest, and accordingly, by an amended Act of 1888, the period was increased to 42 years, and in other respects the terms of purchase were made rather more favourable to companies. A provision was, however, inserted at the same time to the effect that the granting of an order in any locality should not prevent the granting of another order for the same district, and in this way Parliament recognised the principle of free competition. At that time the development of the use of electrical energy to the extent it had now grown was not contemplated, and the idea undoubtedly was that a company getting an order would erect a generating station in the district it was authorised to supply, so that at the end of the terms the local authority would be able to buy out a complete undertaking. While that state of affairs still obtained largely throughout England, in London the position had changed, and they now found that large companies had obtained orders over a number of districts, and supplied those districts with electric energy from one large generating station. A case in point was that of the London Electric Supply Corporation, which had erected a large generating station at Deptford for the supply of the districts of Deptford, Camberwell, Dulwich, Greenwich, Southwark, Lambeth, Westminster and Chelsea. The Committee would see at once the position of affairs. At the end of the period each of these local authorities could purchase the undertaking within its area, but, with the exception of Deptford, none of them would have a generating station, and in the case of Deptford the generating station would probably be too large for the requirements. The way in which the County Council proposed to remove that difficulty was set forth in Clause 3 of the Bill, viz., "Where, under any Act, whether passed before or after the passing of this Act, a company has power to establish a generating station and supply electrical energy generated at such station to any authorised undertakers for distribution, but such company has not the power to supply to persons other than authorised undertakers, then the undertaking of such company shall be subject to purchase, as if the same were an undertaking under the Electric Lighting Acts, 1882 and 1888; and the undertaking shall include any stations and lands of the company used wholly or in part for the purpose of their undertaking, whether within or without the County." If the supply of an undertaking was confined to one district the power of purchase would be exercised by the local authority of the district or by the County Council with the consent of that authority. If the undertakers were supplying more than one district, the power of purchase might be exercised by the local authorities acting in combination, or by the Council. The power of purchase might be exercised under Clause 5 of the Bill by a combination of local authorities or by a majority when these were more than two in number, when authorised by resolution under the Electric Lighting Act, 1882. If the local authorities failed to pass such a resolution and comply with the conditions laid down, it would be lawful for, but not obligatory upon, the Council, with the consent of all such local authorities, or a majority, to exercise the power of purchase. The effect of this would be that if the districts did not wish to combine, and if the majority wished, the County Council might exercise the power of purchase for them. The London County Council could not, however, do anything without the consent of the majority of the local authorities. Under Clause 7 of the Bill, the County Council could be invested with power to supply electrical energy in bulk to any authorised local authority on arranged terms. Other clauses gave power to local authorities or the Council to purchase by agreement at an earlier period than was specified in the Electric Lighting Act, 1888, and power to carry on an undertaking or transfer the business to any local authority within the area of supply. Petitions against the Bill had been presented by nearly all the Electric Lighting Companies

who objected to their undertakings being purchased before the dates mentioned in the Acts. Of the local authorities, all were in favour, with the exception of the City of Westminster, and he thought their objection was based on a misunderstanding. A conference of local authorities was held in 1901, when resolutions were passed in favour of the Bill.

Mr. G. H. Radford, chairman of the Parliamentary Committee of the London County Council, gave evidence to the effect that the Bill was promoted at the request of the local authorities, and it conferred no power on the County Council except those mentioned by Mr. Fitzgerald. They only wished to be able to supply electricity in bulk to local authorities.

Mr. Bryceson, town clerk of Woolwich, was called in support of the Bill.

Mr. Gunyon, one of the County Council's engineers, said the Chelsea, South London, Brompton and Kensington, and the Lewisham and Woolwich Companies could not be directly affected by the Bill, but indirectly the Westminster, St. James's and Pall Mall, the Notting Hill, and the Kensington and Knightsbridge Companies would be affected. The Bill would directly affect the Metropolitan Company, the Charing Cross and Strand, City of London, County of London and Brush, Crystal Palace and District, Blackheath and Greenwich Companies, and the London Electric Supply Corporation. The companies chiefly objected to clause 7 of the Bill, but under that clause the County Council would be only authorised on acquiring any generating station to supply energy in bulk to local authorities. With regard to the objection to the earlier date of purchase that could only be done by agreement with the companies.

In cross-examination, Witness said he supposed that if there were two competing companies in an area, and one was purchased by the County Council, the other would be subjected to rate-aided competition.

Mr. Freeman, K.C., said he was quite prepared on behalf of the County Council to make it that both the companies should be purchased together. If the Central Electric Supply Company's generating station was purchased, the two companies supplied by it would be purchased also.

Mr. Blennerhassett pointed out that Mr. Lough on the second reading of the Bill in the House of Commons gave an undertaking that the majority clause should be abandoned.

After the Committee had conferred together in private, the Chairman said the Committee had come to the conclusion that they would not allow the majority clause. At the same time they were of opinion that some provision should be made in the Bill to guard against the possibility of a very small district, either in regard to population or rateable value, preventing by its objection a desirable combination of local authorities for the purchase of an electrical undertaking.

Other evidence having been called in favour of the Bill, the Committee adjourned.

On the resumption of the hearing, Mr. Blennerhassett, K.C., who appeared for the Corporation of the City of Westminster, addressed the Committee, and pointed out that no fewer than seven different companies were supplying within the area of Westminster, and several of these supplied but a small portion of the area, although they were big suppliers in other areas. The result of the passing of the Bill would therefore practically mean to compel the Corporation to purchase the portions of all these undertakings in Westminster.

Other counsel having addressed the Committee, the Chairman, after a private consultation, declared the preamble not proved.

Lord Windsor's Tube Committee.

On the reassembling of the Committee on Tuesday last week, Mr. Littler, K.C., for the Brompton and Piccadilly Circus (New Lines) Bill, said that his clients were prepared to submit to the Board of Trade the question of the arrangements at the stations and as to the method by which the trains should be worked.

Mr. Perks, M.P., the chairman of the District Railway Company, examined by Mr. Littler, said that the present Bill was authorised in 1897, but at that date the capital could not be found on reasonable terms. That applied at that time to all tube railways. The following year some of the original promoters of the line approached him to see whether the District Railway Company would afford any financial aid. As a result of discussions, he advised the District Railway Company to buy over the rights of the promoters, and to raise the capital and build the line themselves. They accordingly obtained Parliamentary powers to subscribe £200,000 to the line, and a new board of directors was appointed. About the same time they had to face seriously the question of applying electricity to the District Railway. At the time the estimated cost of electrifying the line was £1,250,000, but that had since been enlarged. As the company could not raise the money itself, they entered into an arrangement with a group of investors, who agreed to find the necessary capital. For their part in the transaction they were to receive 5 per cent. on the outlay and the balance in ordinary shares of the District Railway, with a small proportion of debentures. A company had been formed in connection with that matter, and with the tube schemes now before Parliament, with a subscribed capital of 5 millions, of which £1,850,000 had already been paid up. There was no doubt that as further money was required, it would be at once forthcoming. He believed that in about a year and a half the District Railway from Hammersmith to the City would be electrified. Coming to the proposals of the present Bill, Witness said that they had endeavoured to carry out the recommendation of the Joint Committee in such a way as to give accommodation to populous districts, and yet to avoid a waste of capital. It was with that object they had promoted two connecting lines. They had previously purchased the undertaking of the Great Northern and Strand Railway, and they had agreed to commence the construction of the line immediately. To connect that line with the Brompton and Piccadilly, they had decided on a junction line from Piccadilly Circus, running under Leicester Square, and going up Long Acre and Queen Street, and on to Holborn under the new street of the London County Council. That would provide for a through service from Finsbury Park and Wood Green in the north, right away to Kensington and Earl's Court in the west. The estimated expenditure on that piece of railway for works and land was £409,000. From Holborn they would come down to the new crescent in the Strand, where there would be a station. That piece it was proposed to work as a shuttle line. It had been their intention to connect there with Temple Station of the District, but the piece of line had been abandoned in deference to the opposition of the Duke of Norfolk and the London County Council. In order to give another route to the City from Hammersmith, Earl's Court and South Kensington, they were proposing a junction line from Piccadilly Circus down to Charing Cross, where it would connect with the District Railway. The estimated cost of that piece of line was £392,400.

By the Chairman: They would construct their junction at Piccadilly Circus in such a way that they would be able to run either to Finsbury Park or to Charing Cross or the Mansion House, or to both. It would be a confluent junction.

Mr. Littler: We are prepared to leave it to the Board of Trade to say how that junction shall be worked.

Continuing, Witness said that at Brompton Road, just by Cromwell Road, there ran off the Fulham line, which passed through one of the most crowded parts of West London. The line came up again alongside the District at Fulham. They had thus another exchange from Piccadilly with the system of the District Railway. The cost of this line from South Kensington to Fulham was estimated at £837,000. The estimate for the work between Earl's Court and South Kensington was £350,000, for the South Kensington junctions £186,000, and for the South Kensington to Piccadilly Circus £743,000. The electrical equipment was put at £460,000; Parliamentary, law, and engineering expenses, £329,700, and interest during construction. The total estimated expenditure was £3,827,500, with a balance of £305,500, making up the capital of the Brompton and Piccadilly Circus of £4,133,000, to cover financial expenses and other contingencies. The London United Tramways competed with most of their District stations on the western branch, from Hammersmith to Ealing and from Hammersmith to Hounslow and Richmond. They would have stations at Sloane Street, Hyde Park Corner, Albemarle Street, Piccadilly Circus, Leicester Square, Charing Cross, Ludgate Hill, Mansion House and Monument, and the combined railways would open new stations at the Strand, Oxford Street, Tottenham Court Road, Euston Road, Euston Station, Golder's Green, Brompton, Knightsbridge, Hyde Park Corner, Down Street, Russell Square, King's Cross, Caledonian Road, Holloway, Finsbury Park, Bishop's Road (Paddington), Camden Road, Kentish Town, Archway Tavern, Chalk Farm, Hampstead, Dover Street, Piccadilly Circus, Cranbourne Street, Leicester Square, Edgware Road, Lisson Grove, Oxford Circus, Waterloo, Charing Cross, and the Elephant and Castle. When the District Railway was converted into an electrically-worked undertaking, there would be 12 trains per hour from Earl's Court to the City, and 12 trains back, six from Ealing, six from Hounslow, and six from Richmond, all of which would converge and pass through Hammersmith. The Metropolitan Railway proposed to run a five minutes' service from Wimbledon and Putney. Some of the trains would run to High Street, Kensington, and others to the City. It was also proposed to run a two minutes' service from Earl's Court to Piccadilly Circus, and from there, either a two or four minutes' service to Finsbury Park, and a similar service *viâ* Charing Cross to the Mansion House. From Parson's Green on the Fulham line to South Kensington, there would be a four minutes' service. An all-night service would be run probably every 15 minutes on the deep level, and the Brompton, Piccadilly, and Great Northern and Strand line to accommodate those employed at Covent Garden, and in the newspaper offices in the Strand and Fleet Street. The total capital required for building and equipping the Brompton—Piccadilly railways, and the Great Northern and Strand railways, including the sections of the District Railway deep level from Earl's Court to South Kensington, and from Charing Cross to Mansion House, was £7,733,000. Mr. Yerkes and his friends had acquired the Charing Cross, Euston and Hampstead Railway, the Baker Street and Waterloo Railway, the Great Northern and Strand Railway, and the Brompton and Piccadilly Circus Railway.

Cross-examined, Mr. Perks said he had never approached Mr. Clinton Dawkins either on the question of finance or combination. He did not think it would be fair to put the "Bank of England" clause upon them in connection with the proposed railway, but he thought there was a good deal to be said for a clause limiting their liability, say, to three years, in regard to compensation for injury through the working of the railway.

Mr. C. T. Yerkes said he was chairman of the Metropolitan District Electric Traction Company. He generally corroborated the evidence of Mr. Perks as to the financial arrangements for constructing the group of railways which the company had made itself responsible for. It was proposed to have trains of seven carriages, each of which would seat 48 passengers. There would be motor carriages at each end of the train, and one in the centre. The others would be trailers. As to an 11 ft. 6 in. tunnel, he was convinced that a tunnel of that diameter would be perfectly safe, and could be easily worked. However, should the Committee come to

the conclusion that a 13 ft. 6 in. tunnel was preferable, they were perfectly ready to accept such a decision. They had arranged a system of ventilation, by which the air would be changed in the tunnels every 45 minutes. In the tubes the speed of the trains would be about 15 miles an hour, but on the District lines they would be able to increase it to 16 miles per hour. It was not a fact that the contracts for the plant and works would go to America; on the contrary, they would get everything they possibly could made in England. The only reason why any machinery had been ordered in America was that at the moment they could not obtain what they required in this country.

On resuming on Wednesday, April 30th, the CHAIRMAN announced that, for reasons of a distressing kind, Lord Knutsford was unable to be present. He was glad, however, to say Lord Knutsford had consented to remain on the Committee.

After some conversation with reference to the filled-up Bill showing what was really the intention of the Piccadilly & City Company and the other companies which had amalgamated,

Mr. YERKES resumed his evidence, and, in cross-examination by Mr. BALFOUR BROWNE, said the Fulham line and the deep level line from South Kensington to Charing Cross would be worked as a shuttle service unless the Board of Trade permitted them to make a confluent junction. He could not give off-hand the total capital for the whole of the enterprise of the Brompton and Piccadilly Circus and Metropolitan District Railway combination, but the electric equipment part would be less than £1,000,000.

Mr. BROWNE: It is from £15,500,000 to £16,000,000.

WITNESS said he would take it that the total capital commitment of the District Railway Company in respect of the lines owned, jointly owned and leased by them was £12,000,000, and that the cost of the line from Finsbury Park to Earl's Court, and also the junctions in the present Bill, was between £15,500,000 and £16,000,000, and to pay 4 per cent. on the total of £28,000,000 would require £1,120,000 a year. To do that, if they worked at 50 per cent., they would require a gross receipt of £2,240,000.

Mr. BROWNE pointed out that taking a charge of 2d. per passenger, it would mean that the companies would have to carry 270,000,000 passengers a year.

WITNESS said he was convinced that there would be sufficient traffic to make the railways remunerative.

In answer to Mr. COWARD, WITNESS said there would be three shuttle services on their lines, two being from Holborn to the Strand, and one from Parson's Green to South Kensington. He did not think there would be any difficulty about passengers changing.

Mr. BRERETON, the engineer for the Fulham line, stated that the estimate for the land and works of the Fulham line was £826,875. The line commenced with a junction of the authorised line of the Brompton and Piccadilly Circus Company at South Kensington, and went under the Fulham Road to the Parson's Green Station of the District Railway. There would be eight stations, and the line was 2 miles 3 furlongs in length.

In answer to questions, WITNESS said the reason this line was not proceeded with last session was for financial reasons. The King's Road Railway was a rival scheme to this, but he thought there would not be sufficient traffic for both railways. He estimated the cost of an 11 ft. 6 in. tube at £40 a yard and a 13 ft. 6 in. tube at £48 a yard.

Sir H. OWEN, formerly Permanent Secretary of the Local Government Board, gave evidence in favour of the proposed communication between the Brompton and Piccadilly line and the Metropolitan District Railway.

Sir J. SZLUMPER, C.E., the engineer of the Brompton and Piccadilly Circus Railway, described the various Acts of the company, and said the present Bill asked for further extensions of time for the acquisition of land and the completion of authorised works.

In cross-examination as to the danger of the proposed 3½-chain curve, WITNESS thought there would be no danger, but he adopted it from geographical necessity and not from choice.

The Committee adjourned.

On resuming on Friday of last week, the engineer of the authorised Brompton & Piccadilly Circus Railway, Sir JAMES SZLUMPER, was recalled and cross-examined chiefly with regard to the proposal to increase the 3½-chain curve in the neighbourhood of the approach to the station at Charing Cross to a 4½-chain curve. The witness said he did not regard such a curve as a source of danger. It would be necessary for the trains to slacken speed in taking the curve, because of the approach to the station. Their limits of deviation would allow them to go as near as 8 ft. to the Baker Street & Waterloo Railway in Northumberland Avenue, but he was willing to be bound not to go nearer that railway than he possibly could. The outside work of the tunnel of the Piccadilly line, as at present laid out, was 27 ft. away from the wall of St. George's Hospital. They would go further away than that if it was found possible.

By Mr. LITTLER, K.C.: The 4½-chain curve would take the line under the office of the Peninsular and Oriental Steam Navigation Company, in Northumberland Avenue, but only for a short distance. It could not make any possible difference to that company. There was a gradient just before the curve was reached, although the curve itself was on the dead level.

Mr. BALFOUR BROWNE, K.C., handed in to the Committee a filled-up Bill and estimates showing exactly what the City and Piccadilly and the combined lines relied on, and what they had abandoned. He also handed in a copy of the agreements showing the proposed through fares.

It was agreed that the cross-examination on the amended estimates and the agreements should be postponed until the parties concerned had had an opportunity of studying them.

Sir ALEX. BINNIE gave evidence in favour of the proposed extension of the Brompton and Piccadilly Railway eastwards to join the Great Northern and Strand line near the Holborn end of the new thoroughfare of the London County Council, and in his opinion it fulfilled the requirement that tube railways should facilitate communication between the centre parts of London and the suburbs, and thus help to relieve the congestion that now existed in the centre. He should say that the present proposal was the best that had yet been suggested for dealing with the question of London's suburban traffic. The North-East London line would be a great boon to the public. There only remained one link in the system to be authorised to complete it—the extension from Piccadilly Circus to join up with the Great Northern and Strand at Holborn. That was under a mile in length, and would only cost £800,000. The authorised expenditure of £23,000,000 would still remain. In the main, the through route from Hammersmith to Piccadilly was a good one, but a better one might have been chosen if the District Railway had not been in existence. When he gave evidence last year he did not see any possibility of the amalgamation which had been come to between the Great Northern and Strand and the Brompton and Piccadilly Railways and the extension of the last-named line to Charing Cross and Holborn. Those amalgamations and extensions had put a totally different complexion on the matter.

Mr. CHAPMAN said he was chief electrical engineer to the District Railway and also to the present group of tube railways. He had had 27 years' experience of the operation of electric railways in America, and he estimated the cost of the equipment of the seven miles of lines proposed under the Bill would be £460,600. That included £237,000 for the necessary rolling stock. The generating station was to be at Lot's Road, Fulham. It was proposed to work the line on the modified multiple system. The signals would be worked by compressed air governed by electricity, and the block system would be used. When the line was worked by electricity, they expected to make the complete round trip in 50 minutes, as against the 80 minutes it now took. It would be quite possible to run at a speed of 20 miles an hour with stations at intervals of a mile; but as their stations were at much shorter intervals, they would have to keep the speed to within 16 miles an hour. There was no reason why a one minute service should not be maintained.

Mr. HAYES FISHER, M.P., having given evidence in favour of the proposed extension to Fulham, Sir HENRY OAKLEY spoke as to the great convenience which the proposed line would be for passengers on the Great Northern Railway arriving at King's Cross. At present he said there was no connection between the Great Northern King's Cross terminus and the western and central parts of London, but they had obtained one by their arrangement with the Brompton and Piccadilly Company, who had taken over the Great Northern and Strand Railway.

Evidence having been tendered by Mr. C. PEARSON, a surveyor, as to the estimated cost of the land required for the purposes of the extensions, the Committee adjourned.

LORD RIBBLESDALE'S COMMITTEE ON TUBE RAILWAYS

ON Thursday last week a House of Lords Committee, presided over by Lord Ribblesdale, commenced the consideration of a second group of tube railway Bills. The Bills comprised in the group are the following:—Charing Cross, Euston & Hampstead Railway (No. 1), Charing Cross, Euston & Hampstead Railway (No. 2), Charing Cross, Euston & Hampstead Railway (No. 3), Islington and Euston Railway, City & Crystal Palace Railway, Edgware and Hampstead Railway, Great Northern & City Railway, North-West London Railway, Great Northern & Strand Railway, Baker Street and Waterloo Railway. It was decided to first of all take the three Bills dealing with the route from Charing Cross to Hampstead.

Mr. LITTLER, K.C., who appeared for the promoters, explained that the idea of having these tube railways to the Hampstead district was due to the very large population which had sprung up in the northern and north-west suburbs of London. The Charing Cross, Euston & Hampstead line was authorised in 1893, and an extension of time had since been granted. With the opening of the Central London line came an entirely new era. The immense success of that line came as a great surprise, and raised the hopes of supporters of the Charing Cross & Hampstead line. It then came about that Mr. Yerkes conceived the idea that there was an immense prospect for the success of electricity as a means of traction on railways in or near London. The schemes which he contemplated, including this Hampstead line, had a capital of 5 millions. In the present Bill an extension was proposed from an interchange station to Highgate Hill, where the line would join the now authorised light railway of the County Council of Middlesex. Then, in view of the rapidly increasing population north of Hampstead towards Hendon, it was proposed to extend communication to Golder's Hill, again coupling with the County of Middlesex tramway system. The promoters placed themselves in the hands of the Board of Trade as to the size of the tubes, but would prefer tubes of 13 ft. The station at Charing Cross would be in Adelaide Street, at the back of St. Martin's Church, with a subway into the South Eastern Railway terminus. The Edgware extension was not part of this scheme, but the promoters of that line, too, desired to pass under Hampstead Heath. The routes varied slightly, but ran in the same direction, and the promoters would be prepared to accept the decision of the Committee as between the two routes, but it was a *sine quâ non* that the promoters of the present Bill should have control of the tubes from end to end. At Euston Square there might be a subway communicating with Gower Street Station. At Kentish Town there would be an interchange of traffic with the Midland Railway, and

at King's Cross communication would be secured with the Central London Railway, and the London United Tramway system at Uxbridge Road. There was no petition attacking directly the area proposed to be supplied. The convenience was admitted. The promoters had power under various Acts to raise for No. 1 line £1,800,000 by shares and £600,000 by debentures; for No. 2 line £450,000 by shares and £150,000 by debentures; and for No. 3 line £300,000 by shares and £100,000 by debentures.

Replying to the CHAIRMAN, Mr. LITTLER said there was a distinct undertaking, and whenever money was wanted a proportionate amount of shares would be taken. They had five millions provided for the proposed schemes. Turning to petitions against the Bill, he contended that as the line would pass 260 ft. below the surface in London clay at the top of Hampstead Hill, there could not possibly be any injury caused by vibration to Lord Iveagh's property there. The results of inquiry and experiment by Lord Rayleigh's Committee and from experience in Chicago, had led to the adoption of a plan whereby a certain number of the cars would be motor cars, and the use of a heavy springless engine would be avoided, so that it was anticipated that with a deeper permanent way there would be no vibration. There was a petition from the Hampstead Heath Protection Society, which objected to the passage under the Heath. The surface of the Heath would not be interfered with in any way, and the authority that took care of the public interest in that open space had raised no objection to this part of the proposal. The Mayor and Corporation of Hampstead were in favour of the Bill, and he challenged the right of this self-constituted society to a *locus standi*.

The Committee decided not to allow a *locus* to the society.

Mr. W. R. GALBRAITH, C.E., then gave the engineering details of the proposals, and expressed the opinion that Lord Iveagh's property and Messrs. Shoolbred's premises would in no way suffer injury, and he supported this opinion by reference to the results of the construction of the Waterloo and Baker Street line.

Local evidence having been given,

Mr. PERKS, M.P., chairman of the District Railway, and Mr. C. YERKES gave evidence in support of the statements as to the financial stability of the proposals.

It was then announced that an arrangement had practically been arrived at with the promoters of the Hampstead and Edgware line, by which an end-on junction at Golder's Hill would be constructed.

The Committee adjourned.

At the sitting on Friday, further progress was made with the Charing Cross, Euston and Hampstead Railways Bills. It was stated that on behalf of the Hampstead and Edgware line that a satisfactory arrangement had been come to for an end-on junction with the Charing Cross line.

Considerable evidence was received in opposition to the Bill on the part of frontagers.

The CHAIRMAN said he took it that the whole question of frontagers along any line of tube railway was raised by the question, and he understood the points at issue were the nearness of the frontage to the line, the depth of the tunnel and possible interference with foundations.

Mr. GALBRAITH, the engineer of the line, was recalled, and said that when the line was once made structural injury was not caused by vibration. With regard to a protective clause of a uniform character, he feared with so many frontagers a vibration clause might lead litigious persons to make unfounded claims.

Lord ROBERT CECIL urged that in the case of one of the petitioners, Messrs. Shoolbred, a protective clause should be inserted in the Bill, for their property was built on a foundation of waterlogged gravel.

Mr. FREEMAN, K.C., submitted that there was no ground for a protective clause.

After deliberating in private, the Committee declared the preamble of the three Bills proved, and the CHAIRMAN said they were not prepared to impose special clauses on the promoters.

The Edgware and Hampstead Railway Bill was next considered. The proposals contained in the Bill are the construction of a railway, partly underground from Edgware to Hampstead. The first line is 4 miles 4 furlongs and 3 chains in length, commencing in Edgware, near the entrance of Edgware station and terminating in Hendon, and a second railway continues the line from Hendon to Hampstead.

Mr. DAVIDSON, the engineer for the line, gave evidence in support of the Bill, and stated that the railway would be worked in connection with the Charing Cross, Euston and Hampstead Railway.

The Committee declared the preamble of the Bill proved.

Replying to Mr. RAM, the CHAIRMAN said the Committee would not give any binding undertaking with respect to vibration until all the Bills had been heard.

Mr. FREEMAN then opened the case for the Islington and Euston Railway Company. He said the proposal was for a short extension from the Angel, at Islington, under Pentonville Road, passing King's Cross to Euston Square. Originally, the Bill was introduced in the name of a separate company. The City and South London line originally passed from the City to South London. It was the pioneer of these tube railways, and a small line, with a recently constructed extension to the Angel, Islington. After the Central London line had proved a financial success, and the Islington extension had been completed, the City and South London Company felt they were in a position to undertake this additional extension of 1 mile 5 furlongs. It was only a short line, but important, in that it provided connection between several of the great railway companies. The line would have the ordinary double tubes, and would be subject to the ordinary conditions. The diameter of the tubes would be 11 ft. 6 in., with enlargements at the station. The line would be worked by electrical power subject to the requirements of the Board of Trade. The limit of time for works was five years. It was proposed to charge a uniform rate of 2d. a mile, with a clause to secure that workmen's trains should be run night and morning at a return fare of 1d. The capital to be raised was £420,000 by the issue of ordinary and preference shares, and the borrowing powers proposed were for £140,000. The estimate for works was £387,683, leaving a sum of less than £30,000 for contingencies. They were an established company, with good credit, and this margin was sufficient. The total length of the company's existing line was 6¼ miles. The company had always paid 5 per cent. on their preference stock, and on December 31st they paid 2 per cent. on ordinary stock. The total share stock of the company amounted to £2,598,000. The line would be 109 ft. below the surface at the Angel, rising at easy gradients to 70 ft. near Euston, all in London clay. A footway would provide safe exit for passengers in the event of a train breaking down. Each train would consist of a locomotive and four cars, the whole not exceeding 40 tons in weight, the engine weighing 13½ tons. It was proposed to run a 2½ minutes' service during the busier hours. The only opposition to it came from the Metropolitan Railway Company and the L.C.C., and the petition of the latter was in favour of a more stringent clause with regard to workmen's trains, and that was a matter for discussion on clauses. The Metropolitan Railway Company feared the competition of the traffic between King's Cross.

Mr. J. HARRISON, manager of the North-Western Railway Company, contended that the proposed line was a natural extension of the City and South London system, and would tend to develop traffic on the North-Western Railway, and he saw no practical difficulty in the way of conveyance of passengers and their luggage with facilities equal to those afforded by the Metropolitan Railway.

Mr. W. FORBES, of the London, Brighton and South Coast Railway, pointed out the necessity for facilities for passengers to their London Bridge station getting to the northern termini; 22 million passengers were conveyed annually to and from that station.

Other evidence as to the necessity of the line having been called, the Committee adjourned.

On Monday the Committee proceeded to consider and adjust the clauses of the Charing Cross, Euston and Hampstead Railway Bill. Some discussion took place regarding the question of vibration, and, in view of the fact that this matter would also come before Lord Windsor's Committee, it was agreed to allow the matter to stand over.

The CHAIRMAN said that in all likelihood a model clause would be prepared for protection in the case of those likely to be affected by vibration, which would be inserted in all tube railway Bills.

A great deal of discussion took place over the proposals of the London County Council, but amongst the clauses the Committee accepted was one to the effect that the powers granted under the Act should lapse if the company did not within 12 months from the passing of the Act obtain a certificate from the Board of Trade that they had made a *bonâ fide* commencement with the undertaking. The Committee refused to alter the law with regard to limiting the liability of the company to £100 in the event of injury to a workman. They considered, however, that it should be made clear that the 1d. fares for workmen extended to the Charing Cross and the Edgware lines.

Further evidence as to the convenience and need of an extension of the City and South London Railway from the Angel to Euston was then given.

BUSINESS NOTES.

Archbutt-Deeley Water Softeners.—Messrs. Mather and Platt, Limited, have been instructed by the Metropolitan Electric Supply Company to instal a second plant for softening and purifying water by the "Archbutt-Deeley" process for an output of 10,000 gallons per hour. This, with the apparatus installed by them previously, makes a total capacity of 20,000 gallons per hour. The same firm have also been instructed by the Central Electric Supply Company to provide similar plant of a capacity of 23,000 gallons per hour for Grove Road station. Other orders for water-softening apparatus on hand are for the Great Northern Railway of Ireland, Messrs. Belliss & Morcom, of Birmingham, and others.

Association of American Electrical Manufacturers.—A number of manufacturers of electrical appliances and supplies met in New York City last month, and it was decided to form an association composed of the manufacturers who supply products to the electrical supply dealers. It was deemed advisable to do this so as to secure unanimity of action and for the purpose of regulating the individual attitudes of the manufacturers. The new association, our New York namesake understands, will be formed on somewhat similar lines to that of the National Association of Electrical Supply Dealers. The manufacturers represented will comprise the leading ones throughout the country.

St. Helens Cables.—We learn that the Admiralty has again placed a contract for 200,000 yards of rubber cable with the St. Helens Cable Company, Limited, of Warrington; the same company has also obtained the order from the British Thomson-Houston Company for Dialite non-fibrous cables for the Hamilton—Motherwell trams.

Electrical Wares Exported.

Week ending May 7th, 1901.		Week ending May 6th, 1902.	
Alexandria	Value £68	Adelaide	Value £513
Amsterdam	127	Alexandria	74
Bombay	168	Amsterdam	75
Brisbane. Teleg. mat.	98	Bangkok	100
Buenos Ayres. Teleg. mat. ..	150	Bombay	72
Bushire. Teleg. mat.	50	Buenos Ayres. Teleg. mat. ..	343
Calcutta	1,543	Calcutta	260
Cape Town	310	,, Teleg. wire	24
Coatzacoalcos	1,522	Cape Town	372
Colombo	284	Christiania. Teleg. wire ..	27
Durban	558	Colombo	324
East London	38	Cooktown	24
,, Teleg. mat. ..	64	Copenhagen. Teleg. wire ..	51
Gibraltar. Teleg. mat.	121	Durban	4,045
Hamburg. Teleg. mat.	500	Fremantle	55
Hobart	10	Hong Kong	16
,, Teleg. cable	279	Melbourne	120
La Plata. Teleg. mat.	29	Perth	775
Monte Video. Teleg. mat. ..	21	Port Elizabeth	22
Nagasaki	1,695	Rockhampton	280
Ostend	50	Sydney	561
Perth	480	Tokio	48
Rangoon	87	Valparaiso	107
Rio Janeiro. Teleg. mat. ..	943	Wellington	42
Rosario. Teleg. mat.	77		
Rotterdam	38		
Santos	26		
Shanghai	100		
Stockholm. Teleg. wire ..	129		
Sydney	597		
,, Elec. glass globes ..	1,110		
Tokio	28		
Townsville	1,056		
Valparaiso	149		
Wellington	17		
Zanzibar	32		
Total ..	£12,544	Total ..	£8,330

Foreign Goods Transhipped.

Fremantle. Elec. goods	Value £195	Bombay. Telephone ..	Value £34
		Durban. Elec. goods	123
		Hamburg. Elec. machinery ..	17
		Total	£174

Belgium.—La Société des Accumulateurs Tudor, of Brussels, reports a profit of £3,100 for the year 1901.

Books Received.—"Journal of the Institution of Electrical Engineers." No. 156, April, 1902. London: E. & F. N. Spon, Limited. 6s.

"Proceedings of the Physical Society of London." Vol. xviii., Part I., April, 1902. London: Taylor & Francis.

"Report and Minutes of Proceedings of the Committee on Electrical Legislation of the Institution of Electrical Engineers." London: Offices of the Institution. 2s. 6d.

"Working of Steam Boilers," by Ed. G. Hiller, chief engineer of the National Boiler and General Insurance Company, Limited. Third edition. Manchester: Taylor, Garnett, Evans & Co., 1902. 1s.

"Etude Pratique, sur les Différents Systèmes d'Eclairage," by J. Defays and H. Pittet. Paris: Gauthier-Villars. 2 fr. 50 c.

Catalogues, &c.—Messrs. A. J. Beaumont & Co., of 16, Stonegate, York, have sent us a list of designs, printed in colours, of plain and electric Coronation illumination devices.

We have received an illustrated pamphlet from Messrs. Graham, Morton & Co., of Leeds, describing their patent automatic ash discharger, the coal elevator and conveyor, and the patent swinging coal-measuring chamber installed in the Kensington and Notting Hill E.L. works.

Messrs. Royce, Limited, of Hulme, Manchester, have sent us a well-illustrated pamphlet describing some of the types of electrically-driven cranes constructed and erected by them. Several types are included in the list, amongst which are some heavy Goliath cranes for shipyards, &c., overhead travelling cranes, crabs, completely enclosed motor cranes and railway jib cranes and controllers for lifting machinery.

A catalogue has come to hand from Messrs. J. Carter, Sons & Co., Limited, of New Bailey Street, Salford, of their general engineering tools, &c. The list contains very numerous illustrations of the various tools, and a short description is given as to fixing and using many of them.

Messrs. Hodgson, Wright & Wood, of North Parade Works, Halifax, have just brought out a well illustrated price list of their twentieth century continuous-current protected motors, self-starting switches, main switches, &c.

We have received from Messrs. Dick, Kerr & Co., Limited, an excellently got-up book on the design of large generators as manufactured by the English Electric Manufacturing Company, Limited, at Preston. The illustrations are as good as they well could be—they would take a lot of beating. They consist of photographic reproductions of the interior of the East Ham and Portsmouth tramways power stations, where the Preston generators are in use; also of a number of machines on testing beds at the works, and they show the casting, assembling, and other stages in the manufacture and construction of the different parts of these continuous-current generators. The book will be acceptable, we believe, to all interested in power and lighting stations.

The British Thomson-Houston Company, Limited, have sent us copies of the following illustrated lists for binding up with their collection:—No. 122, slow and moderate-speed motors, "M.P." type; No. 123, direct and alternating-current fan motors.

The Lahmeyer Electrical Company has just issued a circular showing its continuous-current generators for direct coupling.

Some neatly illustrated lists have come to hand from the Westminster Engineering Company, Limited, of Victoria Works, Willesden Junction, N.W. One gives prices and details of their continuous-current motors, and the other of the Westminster enclosed arc lamps.

We have received a set of catalogues from the Bergmann Electrical Works, who have opened a sales and engineering office at 11, Farringdon Avenue, Ludgate Circus, E.C. Lists Nos. 1 and 4 are devoted to details and sketches of their watertight steel conduits for electric wiring and parts therefor (plain insulating, brass armoured, steel armoured, and iron armoured insulating conduit); list No. 2 particularises their Swan holders for lamps up to 250 volts, also Edison holders, magnetic lampholders, watertight porcelain sockets and globes; No. 3 giving many illustrations, prices, and so forth for lever switches. A much more imposing list is their catalogue of electro-motors and dynamos of many types and sizes. All of the lists are well arranged and neatly illustrated, and we have no doubt that they will be in demand by the trade and other purchases of electrical apparatus and machinery in London and the provinces.

We have received from the International Electrical Engineering Company, of Clun House, W.C., a copy of their Bulletin No. 6, describing electric tramway apparatus. We are informed that the company laid down the first electric tramway in Belgium so long ago as 1892, and besides carrying out much work on their own account, the Liege works have for many years supplied traction motors, controllers, in quantities to other manufacturers. The Bulletin contains a description and prices of the firm's latest type motors, controllers, lightning arresters, &c., and is well illustrated. Particulars are given of the tractive effort, weights, &c., of standard motors, ranging from 7½ to 35 B.H.P.

Charge of Concealing Shares.—At the Guildhall, after many adjournments, C. Bright and others have been committed for trial on a charge of concealing shares from creditors. Defendants were allowed out on bail.

Dissolutions and Liquidations.—Creditors of the Howell's "Simplex" Anti-Inductive Telephone Syndicate are to send particulars of debts, &c., to the liquidator, Mr. D. F. Basden; 33, St. Swithin's Lane, E.C., by June 14th.

The Electric Fog Signal, Limited, of London, is winding up voluntarily, with Mr. G. H. Carter, of 1, Queen Street, Cheapside, as liquidator.

Duty on Electrical Goods to Norway.—Transformers, which have hitherto been admitted into Norway free of import duty, will in future have to pay a duty at the rate of 5 per cent. *ad valorem*. The duty on incandescent electric lamps has been fixed at 1 kr. 50 ore per kilog.

Electrically-Driven Laundry Machinery.—At the Laundry Exhibition, which is being held at the Agricultural Hall this week, a feature of the show is the electrically-operated laundry machines to be seen at the stand of Messrs. W. Summerscales and Sons, Limited, Keighley. These comprise a high-speed hydro-extractor with a four-pole continuous-current motor mounted directly on the upper end of the vertical shaft, and a 108-in. ironing machine driven by an electric motor through a single spur gear reduction and a long belt. Electrically-driven hydro-extractors are also shown by Messrs. T. Broadbent & Sons, of Huddersfield.

Electricity in Iron Works.—The Electrical Company, Limited, have secured the contract for an extensive transmission of power plant at the Holwell Iron Works, Asfordby, near Melton Mowbray.

For Sale.—Two 12-H.P. "Otto" gas engines by Crossley Bros., two Wilson-Hartnell compound-wound dynamos, 12-KW., 110-volts, with switchboard, and 150-ampere Hookham meter. Offers for the above are required by the Leeds County Liberal Club. See "Official Notices" this week.

German Cable Makers.—It is announced that a syndicate of electric cable manufacturers has lately been formed in Germany with a view of pooling the orders that are to be given out.

Russia.—The Russian Customs authorities have decided that incandescent electric lamps of glass and china, with metallic attachment, are to be classified, for the purpose of import duty, under Section 169, the duty being 10 roubles 20 copecks per pood (equal to 7¼d. per lb.).

Soldering Paste.—The "Electro-Soldine" Company, of Padiham, have sent us a sample of their soldering medium. This is put up in collapsible tubes, rendering it very convenient and cleanly in use. It is stated to be free from acids and other corrosive materials, and should therefore be useful in electrical work.

Summons.—Last week the Lewisham and District Electric Supply Company, Limited, were summoned at Greenwich by the London County Council for laying an electric main in High Street, Lewisham, otherwise than in accordance with plans submitted by them. There were five summonses, two for not giving one month's notice of intention to carry out work, two for doing work without the approval of the Council, and the last for placing an electric main above ground. Mr. Daldy, for the Council, proceeded to enter into details, when Mr. Shaw, for the company, said it seemed to him a case which should be adjourned, inasmuch as the company had appealed against the decision of the County Council to the Board of Trade, and if that appeal were successful the offences were the merest tecnicality. The company did give the

required month's notice, but began the work a few days before the month expired, and on receiving the refusal of the London County Council at once filled in the trenches, stopping the work as soon as the Council objected. Mr. Daldy said the company were required to abandon the work until the Council's consent had been given, and the appeal to the Board of Trade, which was not made until ten days after the issue of the summonses, had nothing to do with this matter. The summonses were adjourned.

The "Armorduct" Wiring System.—We have before us a set of advance sheets of the Armorduct Improved Electric Conduit Company's catalogue describing their improved conduit for electric wiring purposes. Mr. Fred. Bathurst, who needs no introduction to the wiring world, is the general manager of the company, and the offices are at 30, Oxford Court, Cannon Street, E.C. The "Armorduct" is claimed to be a high-grade system of wiring which is the outcome of many years' specialisation in this class of work. An introductory note to the list expresses the view that the expensive and commercially handicapped "double-wire" method of the present day can only be superseded by an economic "single-wire" system using an earthed conduit return, by employing a conduit which is correctly designed to act as a return conductor (through screwed joints), and which will efficiently shield the inner wire by forming for it a mechanically permanent, non-corrodible and waterproof duct or raceway throughout its whole length. We gather that Armorduct is a high grade mild steel welded tube with special bending qualities, and it is manufactured under processes which guarantee a perfectly smooth interior. It is carefully coated inside and out with a superior insulating, flexible and moisture-proof enamel, which preserves the metal from rust or oxidation, and prevents its corrosion by the acids and alkalies contained in plasters and cements. Its object is to compete with standard gas piping in respect to price and ease of manipulation, and it has superior electrical qualifications. It is screwed with a special conduit thread, which ensures easy and rapid fitting with good electrical conducting and water-tight joints, but it can be worked with gas threading tools when preferred. It is claimed to bend cold without splitting. The list gives numerous details and illustrations of the various parts, such as inspection elbows and tee pieces, circular and square-type "knock-out" boxes. The "knock-out" type cast-iron boxes have been specially designed to suit conduit wiring work. Instead of having to use, as heretofore, four styles of boxes, a new, cheap, efficient and water-tight box has been designed, which will serve equally well for four different applications. It can be used as an outlet box to a single conduit equally as well as a four-way intersection box for a double "tap off" by the simple expedient of knocking out with a small hammer (or with the next smaller size conduit) the thin film of metal purposely left across the entrance holes arranged on each face of the box. The end of a conduit can be screwed in the hole by means of a back or lock-nut on the inside, or, if necessary, both the inside and outside. Rectangular faces are specially provided to ensure good mechanical fitting. In order to further increase the utility and general application of the "knock-out" type of box to all systems of wiring, an improved form of tube-end reducing bushing is provided, specially designed to save the use of the inside securing lock-nut, and make it readily possible to effectively work the next smaller size conduit equally well into this type of box. Suitable screwing taps are provided, together with screwed reducing bushings, when it is desirable to screw the conduit directly into the side of the box, as in very damp situations, or, as an alternative, suitable washers can be employed with the back-nuts. A clip-type cover is suited to dry positions and those where the cover has to be removed so that the box can be quickly inspected. The screw-down cover is preferable where waterproofing and mechanical protection are the essential requirements. All screw-down cover type boxes are drilled and tapped in the centre of their base for the purpose of taking the brass centre-pin, by which the makers' specially designed outlet fittings are screwed in the boxes. Where porcelain fittings are not utilised, the centre hole forms a convenient additional means of fastening it in position. Conduit ends, reducing bushings, lock-nuts, wood outlet blocks, and many other parts are included. A number of tools intended for the use of the conduit fitter and contractor are particularised. A wiring outlet fittings list is in course of preparation.

Trade Announcements.—Mr. A. H. Hunt, whose premises at Gresham Street were recently destroyed by fire, has now started again at his new and more commodious address, 115—117, Cannon Street. Mr. Hunt is supplying the trade only, and among his many specialities may be mentioned automatic distance switches, circuit breakers, iron case fuses, fuseboards, switchboards, fancy and cut glass shades and globes of English manufacture, &c. He is also representing the Walsall Electrical Company for the sale of their well-known apparatus, including arc lamps, motors, dynamos, circular switchboard instruments, portable wood case voltmeters and ammeters, and cell testers, and particularly for switchboard work, of which the Walsall Company have so long made a speciality. Mr. Hunt also informs us that he has now been appointed sole representative in this country for the sale of Messrs. Geoffroy and Delore's wires and cables, of which he holds a very large stock in London. A speciality of this firm is twin lead-covered wires and cables, of which large stocks are always held. As mentioned by us last week, Mr. J. Pullar Phibbs has relinquished his connection with Messrs. Geoffroy & Delore.

Mr. G. Braulik says that his Glasgow branch at 155, Bath Street, is now fully stocked, and ready to deal promptly with orders for electrical supplies generally, including bells, telephones, incandescent and arc lamps, flame arc lamps, carbons, and all electrical accessories.

Messrs. Scholes & Son, of Manchester, notify that their Swan Lane stores are in the centre of the city (behind 71, Market Street). The office is still at 85, Corporation Street, Manchester, where all letters, &c., should be addressed.

Ulleswater Hotel Installation.—During the past winter the complete electric lighting of this well-known hotel, situated at Patterdale, in the very heart of the Lake District, has been carried out by Messrs. Gilbert Gilkes & Co., Limited, hydraulic and electrical engineers, of Kendal. The plant presents some interesting and novel features in connection with a private installation of this capacity. There are at present about 200 lights in the hotel, but the plant has been designed in every way for future extensions, and it is proposed during next winter to instal an electric luggage hoist, as well as to add considerably to the number of lights, motors, &c. The motive power is obtained from two 18-H.P. Crossley high-speed oil engines. The dynamos are shunt-wound and provided with fly-wheels, and are of sufficient size to absorb the full power of the engines, giving current at a pressure from 100—150 volts for charging the accumulators. The battery of 55 accumulator cells, having a capacity of 660 ampere-hours, is placed in a room adjoining the engine room. The main switchboard is conveniently mounted on the partition between the battery and engine rooms, and is provided with all the usual switches and instruments. The two dynamo panels are at the sides, the battery panel being in the centre. To facilitate starting the oil engines, the main dynamo switches are made two-way, and provided with a two-way shunt switch with carbon contacts. By this means the dynamos are first connected through a fixed resistance across the terminals of the battery, and, acting as motors, are used to overcome the inertia of the heavy engine fly-wheel and crankshaft and so start the engines. The main switches are then thrown over, putting the dynamos in circuit with the battery through the automatic switches. The necessary correct value of the starting resistance was ascertained by experiment, the starting current being 40 amperes, which rapidly drops to about 10 amperes as the engines speed up. The engine house is a detached building about 100 yards from the hotel, the current being carried from one to the other through a heavy armoured concentric cable. A large oil-storage tank, having a capacity of 500 gallons, is placed near the engine room, the oil being conveyed through a pipe from the bottom of the tank into the room. The exhausts from the engines are effectively silenced by allowing the pipes from the exhaust boxes to terminate in masonry silencers filled with shilloe. The installation was completed in time to be available for the Easter season, when its benefits were much appreciated by the numerous visitors. It will undoubtedly tend greatly towards increasing the popularity of this hotel and its enterprising proprietor, Mr. T. Bownass. The whole of the work had to be carried out between the end of the 1901 season in October and the commencement of the 1902 season in March, and all the material had to be carted over rough fell roads for a distance of nine miles from the nearest railway station; it is interesting to add here that during the greater part of the above period the roads are almost impassable, due to deep snow.

Wolverhampton Exhibition.—The Brockie-Pell Company have some 300—350 lamps now lighting the buildings and grounds of the Wolverhampton Exhibition, which was opened on May 1st.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—An inquiry was held last week by Lieut.-Colonel A. C. Smith, R.E., in response to an application by the T.C. for sanction to borrow £3,725 for purposes of electric lighting and the refuse destructor.

Ashton-in-Makerfield.—In the course of a coroner's inquest on the death of two sinkers, due to a gas explosion in a sinking pit, it was found that the contractor had bared the electric lighting cable with his knife for the purpose of firing shots in the shaft. This is a very serious abuse of the electric lighting system, with lamentable consequences to the innocent victims; steps should be taken to render such tampering impossible.

Bath.—Mr. R. H. Bicknell, L.G.B. inspector, held an inquiry last week into the application of the T.C. for leave to borrow £25,000 for electric lighting purposes. Of this sum, £12,371 was for the purchase of new plant for next winter's lighting, including two 250-KW. steam dynamos, feeders and sub-stations; £11,195 was for capital spent in excess of the amounts already sanctioned. Mr. Francis Teague, city electrical engineer, and Mr. E. Manville, consulting engineer, gave evidence as to the necessity for extensions and the probability of increase in the demand.

Birmingham.—Mr. E. A. S. Fawcett, inspector of the L.G.B., on Tuesday last held an inquiry into the application by the Corporation to borrow £251,974 for the purposes of electric light supply. The town clerk stated that the whole sum would go for additions to existing works and for an entirely new installation. The cost of the site in Summer Lane was £23,174. The area comprised was in extent about four acres, and had a frontage on the Birmingham and Fazeley Canal, private basins and wharfage, and admirable facilities for supplying coal. The amount proposed to be expended upon machinery, new buildings, and additions to existing power stations in Water Street and Park Street was £41,909 3s. 2d., and the erection of the new generating station in Summer Lane was [illegible]et

down at £128,890. The estimated cost of laying new mains, erecting and equipping a sub-station, providing meters, &c., was £58,000. The present generating stations in Water Street, Dale End, and Parker Street, would be working at their full capacity in 1903. There was not sufficient land at those stations for the extension of the works. For the purchase money of the land, £25,174, he asked 60 years, for the erection of buildings, architects' commission, &c., £73,946, he asked 30 years, and for the machinery and apparatus, £152,854, he asked 20 years. Mr. Vaudrey, the city electrical engineer, gave evidence in respect of the scheme.

Blackburn.—As the result of a fierce debate on the subject, some members favouring high speed and others low speed engines, the Electricity and Tramways Committee consented, some months ago, to refer the whole of the tenders received, numbering over 200, to an independent expert. The Committee, on the advice of its engineer, Mr. A. T. Giles, favoured the use of engines of moderate speed. On the nomination of Mr. Hawksley, president of the Institution of Civil Engineers, Prof. Kennedy agreed to act as adviser. His report is in favour of engines of 180 revs. per minute. The tenders were for engines varying from 90 to between 300 and 400 revs. per minute, and the Committee's engineer was in favour of the type recommended by Prof. Kennedy. As some six or eight months had passed since the tenders were sent in, the Committeee considered it desirable to ask two or three of the firms whose tenders were selected by Prof. Kennedy as the best to send in fresh tenders, and the meeting concurred. The names of the selected firms will not be disclosed at present.

Blackpool.—Col. A. G. Durnford, R.E., Inspector of the L.G.B., held an inquiry last week into an application by the Corporation for sanction to borrow £14,000 for purposes of electric lighting and other loans. There was no opposition.

Bristol.—The Electrical Committee has accepted the tender of the British Insulated Wire Company, Limited, for the supply of cable, and the tender of Messrs. Dick, Kerr for the supply of a dynamo at Temple Back.

Canterbury.—The number of consumers of the electric light is now 343, as compared with 259 twelve months ago. The revenue account shows a gross surplus for the year of £2,602 6s. 3d., against £1,885 14s. 9d. in 1901. Principal and interest payments absorb £1,861 12s., leaving, with the balance brought forward last year, a sum of £1,150 4s. 8d. to be dealt with.

Cardiff.—The *Western Mail* has erected on the roof of its premises a 30 ft. staging, surmounted by a signalling arc lamp, for the purpose of announcing to residents of the town and neighbourhood any important occurrence, such as the declaration of peace in South Africa.

Cheshunt.—Mr. H. Wall Wilkinson has been instructed to prepare a report on electric lighting for the U.D.C.

Darlington.—The report of the E.L. Committee shows that the gross profit for the first year of working has been £3,057 4s. 1d., and the expenditure £1,589, leaving a balance of profit of £1,467. Out of that sum £1,377 has been paid in interest upon and liquidation of debt, leaving a net balance of £90 1s. 11d.

Dumfries.—The T.C. has appointed Prof. Capper to prepare a report on the installation of electric lighting in Dumfries.

Durham.—As though there were not already sufficient municipal trading in the county, a resolution has been passed by the County Council to appoint a special committee to investigate and report upon the following points:—(1) How far the County of Durham is covered by electric supply companies working under Acts of Parliament. (2) Inquire as to any special facilities existing in the county for generating electricity by waterfalls, &c., and as to the practicability of such facilities being employed to advantage in the county. (3) Inquire as to the financial results of electric schemes undertaken by municipal bodies. (4) Inquire how far it would be practicable and wise to develop a scheme for an electric supply for the county, or through the medium of Urban and Rural Councils, consistent with Acts of Parliament already obtained by existing companies. It only remains now for Parliament to take up the business of electricity supply.

Lancaster.—The T.C. is to apply for borrowing powers for £25,000 for the extension of the electricity works and tramways.

Leeds.—An explosion occurred in the Corporation electricity works last week, owing to the bursting of a superheater. No great damage was done, happily. It would be interesting to know whether the accident was due to the lack of interlocking gear on the valves for flooding the superheater, a danger to which we have more than once drawn attention.

Little Woolton.—The U.D.C. has decided to apply to the L.G.B. for sanction to borrow a sum of £6,000 for electric lighting and road improvements.

London.—CAMBERWELL.—The town clerk reported that the B. of T. had inserted in the prov. electric lighting order a compulsory purchase clause with respect to the undertakings of other companies than the undertaking that was sought to be acquired. It was formally recommended by the Works Committee that the application for the order be withdrawn. The recommendation was carried, with an amendment to the effect "that this Council strongly protests against the insertion of the compulsory clause by the Board of Trade."

ISLINGTON.—The M.B.C. is protesting against the action of the L.C.C. in requiring a loan of £2,018 for the provision of meters to be repaid within ten years.

GREENWICH.—The Royal Hill Lecture Hall, recently handed over to the M.B.C., is to be wired and electrically fitted at an estimated cost of £290.

MILE END.—The Board of Guardians has come to the singular conclusion that failures of the electric lighting of the Workhouse only occur when the accumulators are used, and has therefore decided to dispense with them, running the dynamos day and night instead!

CITY.—It is stated that the Corporation has threatened to transfer the lighting of municipal buildings and offices from the City of London to the Charing Cross Company, unless the former agree to a reduction in the prices charged.

Macclesfield.—Last month the Electricity Sub-Committee decided to send a sub-committee to visit several towns to view their electricity arrangements and recommend several names from which one might be selected as an expert to advise the Committee. The T.C. last week discussed at some length a lighting and tramway proposal by private parties to form the Macclesfield Light Railways and Electric Lighting Company, and after hearing Mr. L. T. Godfrey Evans, the company's engineer, a resolution was passed in favour of the scheme. We understand that the scheme is a big one, the idea being to run trams to other towns in the neighbourhood at a cost of about £500,000.

Pontypridd.—The D.C. recently decided not to take energy in bulk from the South Wales Electric Power Distribution Company, but to put down its own plant, and Mr. E. L. Hill, the manager of the company, has written to the Council protesting, as a ratepayer, against this "entirely needless expenditure." In another letter, Mr. Hill, writing as manager of the company, states that he has received instructions on behalf of his company, to strongly oppose the Council spending any money on electric plant before an inquiry has been held by the L.G.B., and that he is writing to the Board on the matter. Mr. Hill has further intimated that, as a ratepayer, he will urge the point he has raised in the strongest possible form at the inquiry. The reason given by some of the Pontypridd Councillors for the stand taken by the Council is, that the Council were offered energy at 1½d. per unit, but that they were advised to refuse it unless they could get it at ¾d. per unit, as the Council could make it themselves at ½d. per unit, and that this was actually being done at Dudley. The Councillors considered that they were bound by the advice of their expert. If this is actually the case, the Council is being grossly misled. There is not a local authority in the country that generates electricity at ½d. per unit for works costs alone. In no case are the total costs below 1d. per unit, and in only a few cases are they below 1·5d. per unit, in all but one instance thanks to a traction load. It would be interesting to learn the source of this "electrical expert" advice. The merest tyro knows that a small municipal works cannot possibly compete with a large power scheme in the matter of price.

Seaford.—The holders of the electric lighting prov. order, having failed to get it taken up, have abandoned it.

South Africa.—According to the *B. & S. A. Export Gazette*, the reconstituted municipality of Pretoria is beginning to set its affairs in order. A large outlay on public improvements, including an electric lighting, power and traction installation, will soon become necessary.

The B.C. of Kimberley has obtained sanction to borrow £10,000 for the extension of the electric lighting system, on the condition that it is first ascertained, by consultation with the directors of the De Beers Company, that the latter cannot deliver energy to the Council at a lower rate than the Council can produce it for. Should the company be able to supply energy on advantageous terms, the loan will be diverted to cable extension and other works.

From the same source we learn that a new concern styled the Paarl Electric Power Syndicate, Limited, has recently been floated in the Cape Colony, and is seeking Parliamentary sanction to appropriate a number of streams on the Paarl Mountains for the generation of electric energy and the supplying of the municipality with current for lighting, traction and other purposes.

The T.C. of Bloemfontein proposes to raise a loan of £25,000 for extensions of electricity works and mains. We trust that British manufacturers are alive to all these evidences of activity.

South Wales.—The authorities of Neath, Aberavon and Briton Ferry are to be regarded by the South Wales Electrical Power Distribution Company as one customer, to take a minimum of 150,000 units per annum.

Spain.—The Spanish Government is considering an application for a concession to put down a plant to utilise the water power of the Ursalti, in the province of Biscay, in the generation of electrical energy for lighting and power purposes in a number of small towns in the district.

ELECTRIC TRACTION NOTES.

Aberdeen.—At the Scottish Provisional Order inquiry at present proceeding in Edinburgh—Lord Clifford presiding—the manager of the Great North of Scotland Railway Company, Mr.

Wm. Moffat, opposed the Suburban Tramways Order, and stated that since the Aberdeen tramways had become electrified, the company's suburban receipts had dropped 54 per cent., and that they (the Railway Company) had carried 165,000 passengers less.

Alexandra Palace.—The Islington M.B.C. is opposing the Middlesex County Council's application for a light railway order, and for powers to erect a generating station on the grounds of the Palace, towards the purchase of which the Council paid £14,000.

Alexandria (Egypt).—The Alexandria Tramway Company has received offers, both good and numerous, from the Westinghouse Company, Thomson-Houston Company, of Paris, the Allgemeine Gesellschaft, of Berlin, and firms of similar standing. The Thomson-Houston Company are reported to have made a firm offer to subscribe for 1,500 new shares of the Alexandria and Ramleh Railway Company at something between £31 and £33 per share, and other firms have shown similar eagerness to provide the money required at a good margin over £30. The issue price will, it is stated, be £33. Nothing definite, however, has as yet been decided upon.

Ayr.—By a majority of about three to one, the public, by plebiscite, have given their vote in favour of the running of cars on Sunday.

Birkenhead.—The Electrical Tramways Committee have approved of plans for the new offices of the tramways department. The offices will be erected at the Laird Street depôt, and will cost about £3,700. The committee have decided that the new track, which will double the existing New Ferry route track, shall be paved with wood between St. Paul's Road and the borough boundary. A portion of the track in Balls Road is also to be doubled at a cost of £1,556.

Birkdale.—On Saturday last a five minute service of the electric cars started to and from London Square, Southport, to Birkdale railway station.

Calcutta.—The experiment of electric cars in Calcutta has proved a conspicuous and undeniable success, and it has become quite the fashion for the better classes to take the air at night in the first-class cars on the Kidderpore line. The second-class cars are as heavily patronised as usual by the working classes, who have taken to the new traction quite naturally. The extension of the system will, we are sure, mark a new era of prosperity for the Calcutta Tramways Company.—*Indian Engineering.*

Cavehill and Whitewell.—The Belfast Corporation on 5th inst., resolved to purchase Cavehill and Whitewell tramway or the portion of it running in the borough on terms equivalent to those offered by the B.E.T. Company, and to pay the latter the cost they have incurred in connection with the matter, and to promote a Bill in the next session. The terms, we believe, of the B.E.T. Company were to pay the company their capital in £15,000 6 per cent. preference shares. On the other hand, the Belfast District Rural Council disapproves of the action of the Corporation, and is in favour of the British Electric Traction Company securing the line on the grounds that the Corporation has shown great laxity in the city tramway affairs.

Cranleigh (Surrey).—The Rural Railway Company, Limited, have applied to the Parish Council for consent to promote a light railway to connect Ockley, Cranleigh and Midhurst.

Germany.—A Berlin dispatch to the N.Y. *Electrical World*, under date April 9th, says:—Herr von Thielen, the Prussian Minister of Public Works, speaking in the Diet to-day on the railway Budget, referred to the application of electricity to broad-gauge long-distance railways. He reviewed the recent experiments on the Wannsee and Zossen roads, and said that the traffic on the former, which is a Berlin suburban line, has been abandoned because electricity as a motive power was twice as expensive as steam and less secure from accidents. The insulation was never wholly perfect, and he was, therefore, convinced that the high-power long train system could not be adopted for general introduction. The Minister said, however, that the authorities were negotiating with an electrical company to introduce electrical traction on all trains between Grosslichterfelde (seven miles from Berlin) and the capital, with prospects of better success. Referring to the single-car experiments on the military road between Berlin and Zossen, where a speed of 100 miles an hour was reached, the Minister said he hoped for increased speed through the strengthening of roadbeds, though he was still doubtful as to whether high-speed electrical traction was profitable. He said it must be confined to passenger traffic.

Glasgow.—Mr. Simpson, who recently brought a successful action against the Corporation for running their cars at an excessive speed, has brought up another action on similar lines. The Sheriff, on 28th ult., adjourned further hearing of the case to May 28th.

Gloucester.—A nice little dispute is going on between the Gloucester City Council and the county authority over about 4 miles of road outside the city boundary. The Corporation have recently purchased the city tramways, lock, stock and barrel, for £26,000, and are about to go in for a scheme of electric traction. Mr. Nevins, an American engineer, is also about to construct a system of electric tramways, connecting Gloucester with Cheltenham and Stroud. At present the County Council have decided to give Mr. Nevins the right to construct his line over the piece of roadway in question, and have refused to approve of the city authority going outside its own boundary. A good deal of feeling has been engendered on both sides, and there will evidently be a severe struggle for the possession of this strip of roadway.

Haslemere—Farnham.—It is suggested in the *Farnham, Hindhead and Haslemere Herald*, May 3rd, that an electric system without rails, or pneumatic-tired motor-omnibuses worked from an overhead trolley wire, such as is being installed between Brunnen, Gersau, Vitznau and Weggis, on the Lake of Lucerne, should be constructed between Haslemere and Farnham, connecting Shotter Mill, Grayshott, Hindhead, Headley, and Frensham. This new mode of communication has been referred to, at times, in our columns.

Liverpool.—The Tramways Committee have decided to construct the short length of proposed track between Knotty Ash and Old Swan, two suburban districts to the eastward of Liverpool. This track which will be about a mile in length as regards single line route, will form an important connection, as it will connect the extensive electric car system of the Liverpool Corporation with that of the St. Helens Tramway Company, and will open the way for forming the extensive network of connections projected under the scheme of the South Lancashire Electric Traction and Power Company, the construction of whose lines is now proceeding. Important possibilities are involved in this series of connections, as the Liverpool Docks and many of the manufacturing towns of Lancashire will be brought into touch by means of electric tramways, making the distribution of goods by this means quite feasible. Steps are being taken to arrange for the conveyance of goods over these lines of tramways.

It is stated that a motor mail service between Liverpool and Manchester was inaugurated on 1st iust. The mail contract has been let to the British Electric Traction Company and sublet to the Electric Haulage Company, of Manchester. The total distance to be run is 38 miles.

Maidstone.—The T.C. has decided to apply for an order under the Light Railways Act to construct tramways in the borough.

Northumberland.—At the annual meeting of the Northumberland County Council, held at Newcastle-on-Tyne on the 1st inst., Alderman R. B. Sanderson reported that the Parliamentary Committee had secured the insertion of a clause in the Northumberland Electric Tramways Bill, insisting on a width of 17 ft. between the outside rails of tramlines and the boundaries, inclusive of footpaths.

Oldham.—The Corporation tramway scheme is making good progress towards its ultimate completion. On Thursday last week, Major Druitt, of the B. of T., inspected another of the routes which have recently been finished. In addition to this he also inspected two short lengths which had not been completed on his recent visit, one having to be reconstructed from a double to a single track owing to frontagers' objections, and the other delayed through the widening of a bridge over the canal. There is every probability of the main route from Hollinwood to Waterhead being completed in time for the Whitsuntide holidays.

Salford.—On Friday last electric cars superseded horse traction on the Lower Broughton route at Salford. The effect of this is that the last of the horse cars has been seen at Victoria Bridge.

Spain.—Plans are being prepared for the construction of an electric tramway to connect the Incio iron ore mines, in the province of Lugo, with the railway system, in order to convey the ore rapidly to the port of Vigo.

Weston-super-Mare.—The new electric tramways here were opened for passenger traffic on 5th inst.

Wolverhampton.—Our local correspondent writes:—"The cars on the new Lorain surface-contact system of electric traction commenced running on Wednesday in last week, and since then they have been well patronised. Just now the town is crowded with visitors for the Exhibition, and the service is found to be inadequate. Not only are there not a sufficient number of cars available, but the stoppages are frequent. As a consequence, numerous brakes are requisitioned for the extra traffic, and correspondents are beginning to pour out their troubles in the newspapers. Two or three horses have already suffered electric shocks, though without fatal results, but what is more serious, several pedestrians have been startled by coming in contact with studs left alive. Judging by the periodic examinations to which they are submitted, these studs seem to be a source of trouble. In this connection it should be stated that a man is kept continually passing over the lines, testing the boxes; and on Thursday last, on the occasion of the visit of the Duke and Duchess of Connaught, to open the Exhibition, this man had an amusing experience with the crowd. He meanders along the track to ascertain if by chance any boxes have been left alive. For this purpose he carries in front of him a tray with some delicate instruments, and a couple of canes with which to make the contact. Seeing him pottering about the track with his sticks, a sympathetic old lady—taking him for a blind souvenir seller in doubt—pulled him by the coat sleeve and whispered in his ear, 'Wouldn't you be better on the pavement, my good fellow?' Her interest was, however, misplaced. Another strange feature in connection with this Lorain system is that it appears to be necessary to frequently flush the track with water, an element which must have an important bearing in estimating the merits of this novel mode of traction."

ELECTROMOBILE NOTES.

An article on "The Storage Battery in the Commercial Operation of Electric Automobiles," by W. H. Palmer, jun., appeared in the *Electrical World and Engineer*, New York, April 12th, 1902. The following are interesting extracts from this very valuable and ably written paper:—

"In discussing the merits of the various systems of automobile propulsion, the electrically-driven vehicle is too frequently dismissed with the arbitrary statement that, although ideal in so far as motor controlling mechanism, &c., is concerned, it is rendered impracticable for convenient use by reason of the great weight of the necessary storage battery, its unreliability, and the great amount of attention which it demands. On the other hand, there are not lacking those who maintain that, thanks to the unremitting efforts of the past 10 years, the storage battery is, in the special types furnished for automobile work, freed to a great extent from these objections.

"Electric cab service in New York City was inaugurated in the spring of 1897, by the Electric Carriage and Wagon Company with an equipment of 12 hansoms and one surrey. To-day that service, conducted by the New York Transportation Company, has grown to such proportions that upwards of 300 vehicles are in daily operation, running an average of nearly 5,000 cab-miles per day.

"That the service performed by these vehicles is successful from the point of view of the patrons, is shown by the fact that at rates equal to or in excess of the rates charged for the highest class of horse livery service, far more applications for service are received daily than the company, even with its increased equipment, is able to accept.

"About one and a half batteries are kept in commission for each vehicle operated; of these about two-thirds are at present of the 'Chloride Manchester' type, and one-third of the 'Exide' type, both the product of the Electric Storage Battery Company, of Philadelphia.

"The standard brougham, or hansom, battery of this type consists of 44 cells, having three Manchester positive and four Chloride negative plates. The weight of the battery complete in the tray, with all connecting straps, &c., is 1,790 lbs., and the capacity 108 ampere-hours at the three-hour rate of 36 amperes. Specific gravity of electrolyte, 1,250 when fully charged."

These batteries were originally furnished with corrugated perforated hard rubber separators between the plates, but these were found unsatisfactory for various reasons; one source of trouble was the tendency of these separators to flatten and to form pockets in which the waste of the active material collected, causing partial short-circuits, and weak or "dead cells"; they were replaced by heat-proof material, but the first cost of these perforated corrugated separators, and the breakage on cleaning, was a constant source of annoyance and expense, and they were condemned. The Electric Storage Company replaced them by grooved wood separators, without perforations, $\frac{1}{8}$ in. thick, with vertical grooves $\frac{3}{16}$ in. deep on both sides. The width of the separators is equal to, and the height $\frac{1}{2}$ in. greater than, the plates.

These wood separators have proved satisfactory, and, it is stated, do not increase the internal resistance of the cell. The 44 cells are connected in one series.

"The weight of a standard brougham, with battery, driver, and two passengers, is about 5,300 lbs. Such a vehicle, when in good condition, will consume, at the normal running speed, on level asphalt, about 50 watt-hours per 1,000 lbs. per mile, or 265 watt-hours per vehicle mile. A fair average has been found to be 60 watt-hours per 1,000-lbs. mile—*i.e.*, 144 watt-hours per ton-mile, English—or 318 watt-hours per vehicle mile."

"The capacity of the battery at the three-hour rate is, as stated, 108 ampere-hours. As the average voltage of discharge of 44 cells at this rate is about 84 volts, the watt-hour capacity is about 9,072 watt-hours. The mileage capacity under average conditions will, therefore, be 28·5 miles."

The "Exide" battery has a perforated negative lead sheet pasted on both side with litharge, and is $\frac{3}{16}$ in. thick when finished; the positive is of the cage type with vertical ribs pasted and formed, and when finished $\frac{7}{32}$ in. thick. The separators are of wood, as in the "Chloride Manchester" type, and in addition a plain perforated hard rubber sheet is placed against each side of the positive plate; 44 cells are used as before, weighing, complete with tray, 1,650 lbs., or 140 lbs. less than the "Chloride Manchester" type. The capacity is 156 ampere-hours at the four-hours' rate of 39 amperes, voltage 87, watt-hour capacity 13,572 watt-hours, an increase of 50 per cent. on the "Chloride Manchester" type. Mileage capacity of vehicle 42·7 miles.

The average life of the "Exide" battery is stated to be for negative plates 6,750 miles, and positives 4,500; and the average life of the "Chloride Manchester" battery negatives 20,000, and positives 12,000 miles; or 140 per cent. more than that of the "Exide" plates. Cells of the "Exide" type require cleaning after 1,500 to 1,800 miles, and the "Chloride Manchester" type after 2,400 to 2,800 miles (with the corrugated perforated hard rubber separators the Chloride batteries had to be cleaned after only 600 to 1,200 miles).

A "Daily Trouble report" is given for all the cells:—

"In the new station, with the better care made possible by increased facilities, the number of cases of power exhaustion has been reduced to an average during the last nine months of operation of only 1·31 per 1,000 vehicle miles. These figures include power exhaustion from all causes, and the great majority are due to improperly-oiled bearings, defective motors, snow or mud-covered streets, carelessness on the part of drivers in wasting power, attempts to make abnormally long runs, &c. These figures are being improved upon, but already the showing speaks well for the batteries, and for the system of charging and caring for them.

"The good results secured are also undoubtedly due in a great measure to the improvements made in the vehicles, and to the efficient administration which prevails in the department responsible for their condition. The power consumption has been reduced to the figures given by the change from pneumatic to solid tires, changes in the bearings, and a careful treatment of many other details. The storage battery is the least variable of the many factors involved in electric vehicle operation, yet it is, by the thoughtless, the one most frequently blamed in the event of failure. Disregarding pleasure vehicles suitable only for summer use, over 90 per cent. of the vehicles owned are in constant operation, less than 10 per cent. being the proportion out of commission from day to day for repairs of all kinds." The article concludes, "So far from being an insuperable obstacle to the success of electrically-propelled vehicles, the battery is to-day better adapted to its work than some other portions of the equipment, and, in point of maintenance costs, a smaller factor in the total expense of operation than are, for instance, the rubber tires on the vehicle it runs."

The Americans have succeeded with their electric cab service in New York City, under conditions almost identical with those under which the London Electric Cab Company failed. The batteries are as heavy, the complete carriage, with passengers, weighs 2 tons 7 cwt., and there is admitted great wear and tear of the tires, and at heavy cost; despite this the New York Transportation Company have in five years increased the number of their carriages from 12 to 300, and their perseverance and business management have made their company a success.

The comparative results of the use of the two, almost opposite, types of batteries, are of great importance, and are given below:—

	Weight. Lbs.	Mean volts.	Discharge rate.	Capacity ampere-hours.	Watt-hours per 1 lb. of complete cell.	Car-miles one charge.	Life car-miles.
"Chloride Manchester" type of battery, 44 cells. Heavy weight and low output.	1,790	84	36	108	5·07	28·5	Positives 12,000. Negatives 20,000.
"Exide" type, 44 cells. Ordinary light pasted type with comparatively high output.	1,650	87	39	156	8·2	42·7	Positives 4,500. Negatives 6,750.

It will be noted that the output per pound of complete battery is given as 8·2 watt-hours, as against 12 to 15 watt-hours per lb. of complete battery obtained in this country.

The American company started their operations with the heavier type of battery, and are apparently superseding them with the lighter type. It has been found that the use of a cell of comparatively light weight for great output is more economical in first cost and per car-mile, than that of the heavy type.

One extraordinary feature of the results obtained is the long life in hard daily use of the light pasted type, 4,500 car-miles for the positives; this is equal to over 10,000 ton-miles, and is exceedingly good, and promises well for the future of electric cabs, run under these almost ideal conditions of management.

Correction.—In our "Electromobile Notes" of April 25th, *in re* the motor car exhibition, Mr. Oppermann, one of the exhibitors, was inadvertently referred to as Mr. Oppenheimer.

TELEGRAPH AND TELEPHONE NOTES.

Delany System.—A New York electrical exchange says that the Delany rapid telegraph system, which has been in regular operation by the Pennsylvania Railroad between Philadelphia and Altoona for the past six months, is to be immediately extended to Harrisburg and Pittsburg. The new apparatus was ordered some time ago, and is ready to be installed as soon as the Pittsburg station is ready. About 500 messages, equivalent to 1,000 ordinary commercial messages, are sent daily by the Delany method over the Philadelphia-Altoona wire, which includes a telephone circuit in constant use, without in the least interfering with conversation.

Scarborough Telephones. — The Corporation Telephone Sub-committee has decided to apply to the Postmaster-General for a licence to establish municipal telephones in the district. (*Continued on page 777.*)

THE MANUFACTURE OF GLOW LAMPS.

How many glow lamps are here in use in the United Kingdom? The question does not admit of a reply which can be trusted within any respectable degree of accuracy; but at least we can make an attempt at a solution. From our statistical tables issued early last month, it will be found that the total capacity of the electricity supply stations at work is roughly 400,000 kw. Assuming that 50 8-c.p. lamps are installed for every kilowatt provided, this corresponds with an equivalent lamp connection of 20 millions. Allowing for the facts on the one hand that a very large proportion of the lamps are of 16 or higher candle-powers, that motors are included in the "equivalent lamp connection," and that many stations are by no means so fully loaded as their owners would wish, while, on the other hand, no regard is taken in these figures of the enormous number of lamps supplied with power from isolated plant, we may put the actual number at between 15 and 20 millions. We are open to correction at the hands of those who prefer to make their own guesses.

The Laboratory (Brook Green Works): Squirting the Raw Filaments.

Remembering the enormous capital expended in generating and distributing plant for electric lighting with glow lamps—the proportion to be deducted for motors and arc lamps being inconsiderable—it is curious how little public attention is given to the manufacture of the lamps, which are the very foundation of the industry. Perhaps it is because the individual lamps are not in themselves imposing or impressive, unlike the generators which serve their needs; nevertheless, the process of building-up a glow lamp from the raw materials is one of the most interesting and beautiful that the electrical industry has to show. In the following pages we have endeavoured to place before our readers a detailed account of the manufacture of the Robertson lamp, which is carried on at the works of the Incandescent Electric Lamp Company, Limited, at Brook Green, Hammersmith, under the joint managership of Mr. C. J. Robertson and Mr. C. Wilson.

Winding the Raw Filaments on Carbon Blocks.

Setting in the Carbonised Filaments.

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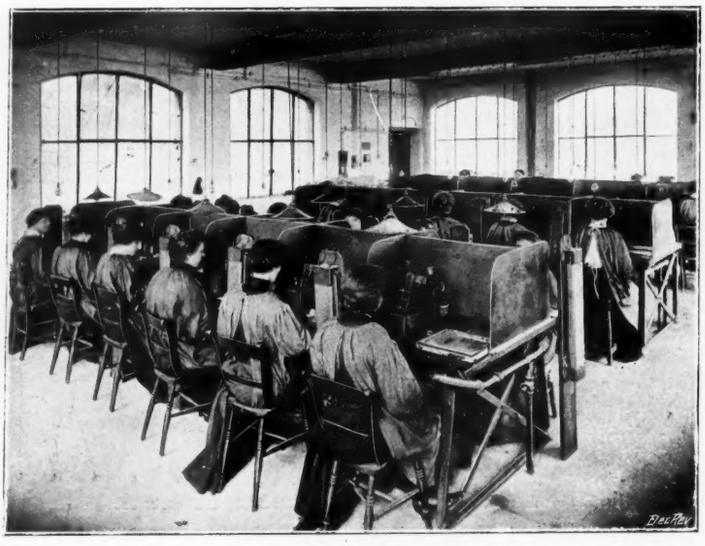
It is a remarkable fact that the actual processes involved in the manufacture are practically identical with those in vogue seven years ago, when we gave a brief description of the works, which at that time, however, were relatively small compared with the present extensive premises. Then, the annual output was but half a million lamps; now it is more than 2½ millions per annum, and is rapidly increasing.

The parchmentised cotton process of Swan, formerly so popular, has given way to the solution of cotton wool in zinc chloride, now practically universally in vogue. Pure cotton wool is employed, and is dissolved in a hot solution of zinc chloride, the relative proportions of the raw materials, the strength of the solvent, and the temperature being carefully regulated to obtain the best results. The product resulting from this process is a dark brown viscous fluid. It is highly important that this should be entirely free from bubbles; in order to avoid these, the fluid is drawn out of the mixing vessel into glass flasks, by producing a partial vacuum in the delivery tubes, air pumps being provided for this purpose. A row of flasks, in which



View of Mounting Room.

number of tall glass jars, nearly filled with alcohol, are surmounted by a system of tubes connected with the tanks; a tube drawn out to form a nozzle with an orifice of definite diameter dips into the alcohol in each jar, and the liquid is drawn from the tanks and squirted through these nozzles by means of compressed air. The effect of the alcohol upon the emergent liquid is to immediately solidify the latter, so that the liquid jet becomes a solid filament, which gathers in coils at the bottom of the jar; so regularly does the process take place that in the case of the thicker filaments each turn lies exactly upon the preceding one, and a slightly conical turret is gradually built up, forming a remarkable and pretty object.

After this process the newly-formed filaments are washed for a long period in trays of running water, until every trace of the re-agents employed has been removed.

The next step is to dry the filaments; for this purpose they are loosely wound on drums covered with thick velvet, which possesses the double advantage that the long pile provides an elastic and yielding bed for the filaments, while

Detail View of Mounting Apparatus, Open.

Process of Flashing the Filament.

the process of extracting air is taking place, may be seen in the background of our view of the laboratory.

After standing for some time in the tanks, the liquid is converted into solid filaments by a most simple and beautiful process, illustrated in the foreground of the same view. A

at the same time it permits of the access of air to all sides of them, so as to ensure uniformity in drying. The filaments at this stage are uniform, smooth and perfectly cylindrical threads, of a yellowish colour (the brown hue disappears at the moment of formation of the filament when the jet comes

in contact with the alcohol); the thread is weak, and somewhat brittle, so that it has to be carefully handled. In course of drying the filament diminishes enormously in thickness—about two-thirds—and shortens also (hence the advantage of the velvet covering on the drums).

Apparatus for Flashing Process.

The next process is that of winding the filaments on carbon formers, in preparation for carbonisation. This is shown in one of our views. Taking a bunch of cut filaments, the operator fixes the ends on the carbon block with melted wax; by clever manipulation, the bunch is quickly flattened out into a single layer, and is then formed into a horse-shoe shape by bending over the rounded edge of the block, or into a spiral by taking one or more turns round a carbon rod attached to the former, after which the free ends are fastened down with wax as at the commencement. Several bands are wound on each former in this way.

The wound formers are then packed in a mass of carbon dust in a crucible, which is raised to an intense white heat in a furnace, care being, of course, taken to prevent access of air to the filaments. After baking for several hours, the crucible is slowly cooled—the whole process of carbonisation occupying the better part of a day. During the operation, a further shrinkage, both in length and diameter, takes place, the former being rendered possible by the softening of the wax, which allows the ends of the filaments to retract.

The filaments are now extremely hard and elastic—hard enough, in fact, to scratch glass; they consist of practically pure graphite. There are few more remarkable products of human handiwork than glow lamp filaments: in purity, structure, and shape they are marvellously near perfection, and form a striking contrast with the soft white filaments from which they are composed.

The next step is to attach the platinum leading-in wires to the ends of the filaments. As is well known, platinum is the only metal which has a coefficient of expansion as small as that of glass, and its use is, therefore, obligatory in order to secure a durable vacuum and to avoid fracture of the glass; but it is a very costly material, and therefore the wires are, naturally, neither longer nor thicker than required to carry the current to the filament. Having been cut in short lengths, one end of each wire is flattened in a little mill, and the wire is then drawn through a circular die, which converts the flattened end into a tube. The filament having been cut to length by gauge, each end is inserted into one of these tubes, and the latter is flattened so as to grip the filament with a pair of forceps, as shown in our view of the "setting-in" process.

Up to this point no tests have been mentioned, as none are necessary; but here commences the long series of tests of which every lamp and filament has to run the gauntlet—indeed, the manufacture of the lamp may almost be called a series of tests. The diameter of every filament is now measured by means of a simple micrometer, those which fail to pass this test being discarded.

The next process is perhaps the most interesting of all, namely, the mounting. One of the greatest obstacles in the path of the early lamp makers was the joint between the carbon and the platinum, and numerous ingenious devices were adopted to effect the junction. The method which has proved itself the fittest to survive is the deposition of carbon upon the joint, by heating the latter to whiteness in a fluid hydro-carbon. This process is in itself a triumph of ingenuity, and the result attained by means of it is most admirably adapted for its purpose, consisting of a hard, dense sleeve of pure carbon, adhering closely to both the platinum wire and the carbon filament. Almost any fluid hydro-carbon is applicable to the process, whether liquid or gaseous, but the best results are obtained with benzine. This is a most inflammable substance, and, although there is no danger so long as the white-hot joints are wholly immersed in the liquid, there is certain to be a blaze if the heated parts are above, or very near, the surface. This was always a grave drawback to the use of benzine, until the Robertson Company took the matter in hand; they, however, devised a system which meets all objections, and has been specially adopted by the inspectors of the London County Council as a standard for use in all glow lamp factories under their control.

The "mounting room" is shown as a whole in one of our views, from which it will be seen that the operators work at slate benches, which are divided into compartments by sheet-iron partitions. In each compartment there is a tank about 9 in. deep, and 8 × 4 in. in plan, made of iron,

Sealing Filaments in Glass Bulbs.

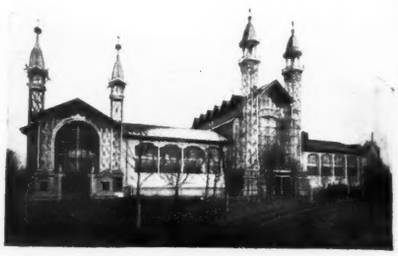
to contain the benzine; this is provided with a hinged lid, which can be closed instantly in case of a flare-up, so as to extinguish the flames. Close against the back of the tank is an air duct, through which a constant down draught is maintained by means of pumps; by this means

the vapour which is constantly rising from the surface of the benzine is removed. Beneath the bench is a system of iron pipes connected with each of the benzine tanks; by opening a valve at the side of the room, the whole of the tanks can be instantly emptied of their contents, which are discharged at a safe place outside the building. The building itself in which these operations are carried on is isolated from the main buildings, access being gained by a covered bridge. Lastly, each of the operators is provided with a fireproof apron, which is treated anew every week so as to maintain its incombustible qualities unimpaired.

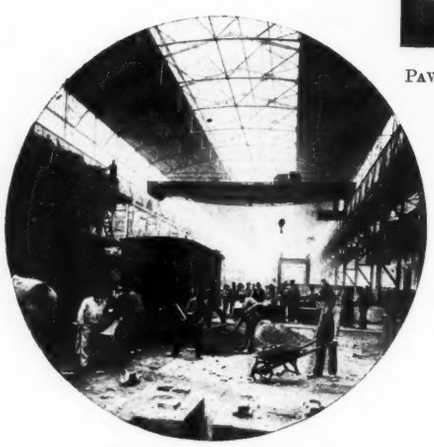
made to press lightly against the two legs of the filament a short distance from the joints, the legs being supported by a corresponding bar at the back; by this means the filament is short circuited, the current being confined to the joints. Having clamped the filament in position, the operator lowers it into the bath of benzine; a small current is then switched on, and brought up to the required strength by means of a sliding rheostat, as shown on the left of the view. The process can be watched and regulated throughout; when it has been carried far enough, the operator first cuts off the current, and then removes the filament. The current strength

Pavilion of the Hörder Verein.

Municipal Art Gallery.

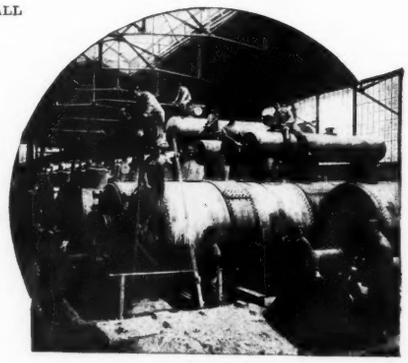


Pavilion of the "Good Hope" Forge and the Deutz Gas Engine Works.



Interior of Machinery Hall During Preparation.

Front of Machinery Hall.



One of the Boiler Houses.

Düsseldorf Exhibition.

That these precautions are by no means superfluous will readily be understood; that they are effectual may be gathered from the fact that though from time to time "flare-ups" occur, there has never been any serious accident in connection with this department.

A separate view is given of one of the benzine tanks, showing also the apparatus used for the mounting process. This consists of a counterbalanced pivoted lever, which carries at the outer end a pair of grips for the platinum wires; the grips are connected with a circuit maintained at a suitable voltage. A metal bar is carried on an insulating arm, which is hinged in such a way that the bar can be

required is considerable, as much as 10 amperes being used for an 8-c.p. 200-volt glow lamp; but no ammeter is considered necessary, as the current required varies according to the size of filament, temperature of the bath, &c.

The next step is the flashing of the filament. Although the carbonised filaments have a hard, smooth surface, and are very nearly homogeneous, a still better result can be obtained by depositing carbon over the whole length of the filament. The deposit has a very low specific resistance, so that it can be used as a means of regulating the resistance of the filaments; it also gives a very hard surface, of low emissivity and greater durability than the unflashed surface.

The filament is clamped in terminals on a flat plate, upon which a bell glass can be lowered. The air is then removed from the interior of the glass by pumps. When a sufficient vacuum is attained, benzine vapour is admitted to the glass, at a very low pressure, by means of a three-way cock, and the filament is raised to incandescence by passing a current through it. During this operation it is viewed through a blue-tinted glass, to avoid dazzling the eyes of the operator. The latter is able to judge of the effect produced by the degree of incandescence, and is also able to make actual measurements of the resistance by means of a bridge and galvanometer. Thus it is possible to obtain very uniform results in candle-power and efficiency. The apparatus is so designed, with counter-balanced bell-glass, switches, rheostats, &c., as to facilitate, as far as possible, the carrying out of this important process. As only small quantities of inflammable vapour are used, and these are under control all the time, practically no danger is attendant upon the process.

The filament is now completed, ready for sealing into the bulb.

(*To be concluded.*)

THE DÜSSELDORF EXHIBITION.

On Thursday last week this Exhibition of German National Industry and Art was formally opened by the Crown Prince. Although the Industrial exhibits are limited to the products of the provinces of Rhineland and Westphalia, a splendid collection of manufactures has been brought together, illustrating in a striking manner the extraordinary progress which has been made by German industry since the Düsseldorf Exhibition of 1880.

Düsseldorf itself is called the "Garden City," and the appellation is well bestowed; the beautiful Hofgarten and the People's Park are delightful and attractive resorts, and at this season, when the foliage is at its freshest and the weather is still cool, they are veritable glimpses of fairyland. Düsseldorf is noteworthy, too, on the score of its remarkably well-organised and comprehensive system of municipal government; parks, theatres, the harbour, tramways, gas, water and electricity works, nursing homes, and abattoirs, all are owned and controlled by the city authorities, and so far as one can see, the result is highly satisfactory.

The Exhibition grounds, which cover an area twice as large as those of the Glasgow Exhibition of 1901, extend along the right bank of the Rhine for about 2,000 yds., with an average width of 300 yds., and include a large portion of the Hofgarten. The Machinery Hall covers an area of 5 acres, and consists of a lofty central bay, 840 ft. long, flanked on either side by a smaller bay. The arched roof consists of iron and glass, affording excellent lighting; numerous electric cranes, lifting up to 30 tons, serve the three bays, and a range of 20 boilers provides a supply of steam for the running plant. The Industrial Hall is half as large again, and there are numerous pavilions in the grounds, the largest of which is that of Messrs. Krupp Brothers, containing a magnificent display of guns, armour-plate and ammunition, screw propeller shafts, &c.

The most important electrical exhibit is undoubtedly that of the Elektrizitäts Aktien-Gesellschaft, vormals W. Lahmeyer & Co., of Frankfurt; apart from their pavilion, the company have provided no less than 15 electric generators out of 29 used for the supply of electricity for lighting and other purposes in the Exhibition. Amongst these there is a 330-KW. 10,000-volt single-phase alternator, running at 94 revolutions per minute; a 2,000-KW. three-phase alternator, and several smaller ones, working at 5,000 and 2,000 volts; and a large number of direct-current machines, of which the largest is of 440-KW. capacity.

The Helios Elektrizitäts A.-G., of Köln-Ehrenfeld, show a three-phase 2,000-volt generator of 1,300-KW. capacity, running at 72 revolutions per minute; the Deutsche Elektrizitäts Werke, of Aachen (Garbe, Lahmeyer & Co.) have several dynamos and one alternator at work; Messrs. Max Schorch & Co., of Rheydt, also show one alternator and a number of dynamos, and Messrs. Ernst H. Geist, of Köln, exhibit a dynamo and motors. In addition, there are several dynamos used for electricity supply by exhibitors, apart from the central station plant, and an enormous number of motors.

The ruling tendency of the exhibits is towards low speeds and horizontal engines — exactly the opposite of the Glasgow Exhibition; further, the majority of the engines are of the compound tandem type, with one crank, direct coupled to the generator. The valve gear takes a variety of forms, every maker apparently possessing his own special type; trip gears are common, though many engines are equipped with simple double-beat valves operated by mechanism of the positive-action type.

Several vertical engines are shown, the finest being the 3,000-H.P. engine of the Gutehoffnungshütte, coupled to the large Lahmeyer three-phase generator; none of these runs at a higher speed than 225 revolutions per minute, and all are of the open type. The build of the alternators and dynamos is of remarkable uniformity, but little in the way of novelty being noticeable.

The views of some of the features of the Exhibition and of the city, which we reproduce on p. 776, will afford an indication of the character of the buildings; their contents will be dealt with in later issues.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page 772.*)

Emden-Vigo Cable.—The working operations of the German Marine Telegraph Company, whose general meeting has just been held at Cologne under the presidency of the Marquis of Tweeddale, were severely prejudiced by the interruptions in the Emden-Vigo cable during the past year. The first fault arose on January 28th and continued until March 13th, says the *Financial Times*, whilst the second interruption was of shorter duration, having extended from November 1st to the 9th of the same month. The repair of the cable at the first break occupied a considerable time in consequence of the unfavourable weather, and greatly increased the expenditure. The net profits for 1901 amount to £6,189, as compared with £12,058 in the previous year, and the dividend declared is at the rate of 3 per cent. as against 5 per cent. for 1900.

German-American Cable.—A daily press telegram from Berlin says that the German cable steamer *Podbielski* has received orders to take soundings and measurements in the Atlantic Ocean preparatory to laying a new German-American submarine cable.

Manchester Telephones. — At a meeting of the Telephones Committee of the Manchester Corporation held on Tuesday, it was decided to recommend the withdrawal of the Manchester Telephone Area Bill now before Parliament.

Southport Telephones.—The Corporation are taking steps in regard to municipal telephones. A draft copy of the telephone license has been forwarded to the Town Clerk by the Postmaster-General, and is now under consideration. The license permits the Corporation to include in its telephone area the whole of the Ormskirk Union with the exception of Birkdale.

Swedish Telephones.—A Bill is about to be laid before the Swedish Parliament, states the British Consul (A. S. MacGregor), for the purchase by the State of the rights and stock of the two private telephone companies — Allmänna and Bell. The price wanted is given as altogether about £711,110.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Alexandria-Larnaca	Jan. 19, 1902 ..	..
Puerto Plata-Martinique	May 5, 1902 ..	..
Landlines :—		
"Via Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..
Guanta-Barcelona	March 17, 1902 ..	..
Berlin-Versovic	March 31, 1902 ..	April 2.
Barcelona-Ciudad Bolivar	March 6, 1902 ..	..
Puerto Plata and San Domingo	April 26, 1902 ..	..

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking.—June 6th. Motors, pipework, chequer plating, &c. See "Official Notices" to-day.

Bedford.—May 17th. Fuel economisers for Corporation. See "Official Notices" April 25th.

Brighton.—May 12th. Boundary wall and extensions to the tramway car sheds for the Corporation. See "Official Notices" May 2nd.

Brighton.—June 9th. Points, crossings, tie-bars, bolts, &c., for the Corporation tramways; also 300 tons of steel rails. See "Official Notices" to-day.

Bury.—May 20th. Jet condenser and pumps for the electricity works. See "Official Notices" May 2nd.

Coventry.—May 26th. Steam and water pipes and accessories. See "Official Notices" to-day.

Dartford.—May 10th. 300-KW. steam dynamo, piping, and switchboard instruments; Lancashire boiler, feed pump, &c. See "Official Notices" April 25th.

Dublin.—May 13th. Tenders are being invited by the Lighting Committee for the construction of a cast-iron subway under the Grand Canal Dock near the Victoria Bridge in connection with the municipal electricity supply undertaking.

Dudley.—May 20th. Motors for the E.L. Committee. See "Official Notices" to-day.

France.—May 15th. The French Post and Telegraph authorities in Paris are inviting tenders until 15th inst., for the supply of 550 tons of copper wire. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glamorgan.—May 31st. Electric wiring, &c., for Parc Gwyllt and Angelton Asylums, near Bridgend. See "Official Notices" to-day.

Glasgow.—June 7th. Economiser and condensing plants. See "Official Notices" to-day.

Govan.—May 27th. Fuse boxes, meters, demand indicators, manhole and joint boxes, &c., for 12 months for the electricity department. See "Official Notices" to-day.

Halesowen.—May 21st. The Council wants offers for taking over its electric lighting and light railway powers. See "Official Notices" May 2nd.

Hungary. — September 1st. The authorities of Kolozsvár, in Hungary, want to introduce electricity for lighting and power purposes. See "Official Notices" to-day.

Ilford.—May 13th. Three 10-H.P. electric motors for the U.D.C. electricity department. See "Official Notices" May 2nd.

London, S.W.—July 31st. The War Office wants tenders for self-propelled lorry (oil). See "Official Notices" April 25th.

Middlesbrough.—The electric wiring of the Large Hall at the Royal Exchange. J. M. Bottomley & Son & Welburn, architects, 28, Albert Road, Middlesbrough.

Oldham.—May 20th. Cables, troughing, bitumen, and insulators for the Greenhill station. See "Official Notices" to-day.

Poplar.—May 28th. Wiring (conduit) and fittings at Union Offices. See "Official Notices" to-day.

Roumania.—May 31st. Tenders are being invited until May 31st by the municipal authorities of Calarashi—Stirbeiu for the concession for the electric lighting of the town during a period of 35 years.

Swansea.—May 10th. Installation for the Free Library, art schools and gallery for the Corporation. See "Official Notices" May 2nd.

Stockport.—May 21st. One water-tube boiler for the electricity works at Millgate. See "Official Notices" to-day.

Swindon.—May 14th. Free wiring proposals for the Corporation. See "Official Notices" May 2nd.

Swindon.—May 19th. 252 accumulator cells and accessories for the Corporation electricity works. See "Official Notices" May 2nd.

Wallasey.—May 17th. The U.D.C. invites tenders for the maintenance of the electric installation on their steamers for a period of 12 months from July 1st next. H. W. Cook, Clerk, Public Offices, Egremont, Cheshire.

West Ham.—May 13th. Steel chimneys, fans and engines for induced draught, economisers, &c., for the electricity works. See "Official Notices" May 2nd.

CLOSED.

Dundee.—The Tramway Committee has considered tenders for a new triple-expansion engine and dynamo for the electricity station, and has accepted the offer of £6,215 by Messrs. Dick, Kerr & Co.

Falkirk.—The tender of Messrs. Belliss & Morcom, Limited, has been accepted for the engines by the above Town Council.

Grimsby.—At a meeting of the T.C. on April 28th, the following tenders to the plans and specifications prepared by the borough electrical engineer, Mr. W. A. Vignoles, were accepted:—

220-KW. dynamo, and Belliss engine (98 tenders received), British Westinghouse Company, Limited (accepted) ..	£2,377
Extension of switchboard, and supply of motor boosters (12 tenders received), The Britannia Company, Colchester (accepted)	596
Battery (9 tenders received), Tudor Accumulator Company (accepted)	905
Condensing plant, cooling tower, &c. (24 tenders received), W. H. Allen & Co., Limited (accepted)	1,748
Pipework, Sir Hiram Maxim E.E. Company, Limited (accepted)	585
Water-tube boiler, with Erith underfeed automatic stoker (7 tenders received), Stirling Boiler Company, Limited (accepted)	1,151
	£7,362

This plant is required to meet the load next winter. On April 8th the Town Clerk received the sanction of the L.G.B. to borrow an additional £17,000, £4,100 being for accounts overspent, and £12,900 for extensions of plant and mains. This makes the total capital expenditure sanctioned by the L.G.B., £72,000.

Halifax.—The Electricity Department has accepted tenders from the British Thomson-Houston Company, Limited for the supply of two 200-KW. rotary converters for £1,304; one high-tension switchboard for the sum of £332. Also the tender of the British Electric Transformer Manufacturing Company, Limited, for the supply of seven 75-KW. single-phase transformers for the sum of £798, subject to the transformers being made suitable for work in conjunction with the rotary converters and high-tension switchboard to be supplied by the British Thomson-Houston Company.

Heckmondwike.—The following tenders have been accepted by the U.D.C. for the extension of their electric lighting station:—Section A, steam piping, Messrs. Thornton & Crebbin, Bradford; Section C, battery, the Chloride Electrical Syndicate Limited, London; Section D, switchboard, Mr. Bertram Thomas, Manchester; Section E, condenser, Messrs. Thornton & Crebbin; Section F, cooling tower, the Worthington Pump Company; Section G, cables, Messrs. Henley, Limited, London, Further inquiries are to be made by the committee with respect to B, engines and dynamos.

London.—The London County Council received eight tenders for the supply of about 48 miles of high-tension cable and ten offers for 100 miles of low-tension cable required in the reconstruction of the tramways. One of the tenders for the former, and two of those for the latter, were not in accordance with the specification. The tenders in proper form are given below:—

HIGH-TENSION CABLES.

St. Helens Cable Company	£31,454 12 6
Siemens Bros. & Co. (accepted)	31,748 17 6
Western Electric Company	31,849 18 6
British Insulated Wire Company	33,371 17 6
Callender's Cable Company	34,782 6 8
W. T. Henley's Telegraph Works Company ..	34,799 17 8
Land und See Kabel Werke Aktien Gesellschaft, Cologne	40,464 19 4

LOW-TENSION CABLES.

St. Helens Cable Company	£47,298 5 0
British Insulated Wire Company (accepted) ..	49,499 12 6
Western Electric Company	49,964 6 8
Siemens Bros. & Co.	50,523 5 0
Callender's Cable Company	54,293 11 8
W. T. Henley's Telegraph Works Company ..	54,303 6 8
Johnson & Phillips	56,518 8 3
Land und See Kabel Werke Aktien Gesellschaft	61,478 5 4

The Highways Committee, in reporting to the Council on Tuesday, stated that the lowest tender in each case was that of the St. Helens Cable Company. The tenders had been carefully examined and the Committee were advised that the most satisfactory were that of Messrs. Siemens Bros. for the high-tension cables, and that of the British Insulated Wire Company for the low-tension mains. The Committee understood that the samples submitted by the St. Helens Cable Company were not of an entirely satisfactory character for the purpose for which the cables are required, and the company had not in either case submitted a complete tender, certain information having been omitted. The times for delivery specified by the British Insulated Wire Company and Messrs. Siemens Bros. were quite satisfactory, and the Committee recommended the acceptance of their tenders for low and high-tension cables respectively.

Mr. A. M. Torrance remarked that the St. Helens Cable Company, which had submitted the lowest tender in each case, had satisfactorily executed work for the Council, and they were willing to comply with the requirements of the Council's engineer. The difference in the amounts was £2,400, and he hoped the chairman of the committee would give some explanation of the course proposed to be adopted.

Mr. J. A. Baker, in reply, stated that the cables of the company referred to, were not found to be so satisfactory for the particular work required in connection with the tramways as those of the other two firms whose tenders were recommended for acceptance. The company had done work for the Council in the lighting of the embankment, but in the present case the Committee on the advice of Dr. Kennedy and the Council's experts had no option but to accept the tenders proposed. Besides, the company had not filled up the form of tender with the rates of wages.

The recommendation of the Committee was then carried without further discussion.

London.—ISLINGTON. The Borough Council has entrusted Messrs. Rowland Carr & Co., of London, with the supply of 72 arc lamp columns required for Highbury arc lighting extensions.

Manchester.—Messrs. Higginbottom & Mannock, of Gorton, Manchester, are supplying the Manchester Corporation with a 20-ton electrically-driven overhead travelling crane for the Stuart Street electricity station.

Morley.—The Corporation has accepted the tender of Messrs W. T. Glover & Co., Manchester, for the supply of cable for house connections. The tender of the Morley Electrical Engineering Company for the supply of two electrical exciters for the sum of £104 has been accepted by the Corporation.

Salford.—The Howard Conduit Company, Limited, of Trafford Park, have received from the Salford Corporation the contract for 12 months' supply of asphalt troughing.

FORTHCOMING EVENTS.

Friday, May 9th.—At 7.30 p.m. Institution of Civil Engineers. Students' annual dinner at Restaurant Frascati.

At 7.30 p.m.—National Telephone Company's Dinner at the Trocadero Restaurant.

Saturday, May 10th.—At 10 a.m. Institution of Junior Engineers. Visit to the Great Eastern Railway Works, Stratford.

At 10 a.m. Institution of Electrical Engineers (Students' Section). Visit to Messrs. Elliott Bros.' works at Lewisham.

At 7.30 p.m.—Electrical Engineers R.E. (Volunteers) Cycling Club. Bohemian Concert at headquarters, Regency Street, S.W.

Monday, May 12th.—At 3.30 p.m. Institution of Electrical Engineers. Conference at the Society of Arts *re* Factory Act.

Tuesday, May 13th.—At 8 p.m. Institution of Electrical Engineers (Glasgow Section). Meeting at the Institution of Engineers and Shipbuilders, 207, Bath Street.

Wednesday, May 14th.—Royal Society. Annual conversazione.

At 4 p.m. Institution of Electrical Engineers (Birmingham Section). Visit to the Corporation Electricity Works. At 7.30 p.m. Meeting at the University.

Thursday, May 15th.—At 8 p.m. The Institution of Electrical Engineers. Extraordinary general meeting at the Society of Arts. Paper on "Electrical Traction on Steam Railways in Italy," by Prof. C. A. Carus-Wilson.

NOTES.

Electrical Vehicle Trials.—The Secretary of the Automobile Club has sent us a preliminary notice regarding the trials of electric vehicles which are to take place from July 7th—12th, 1902. The trials will last five days, and cars may be entered in either of the following classes:—(1) Town carriages; (2) country carriages weighing *over* 30 cwt, including accumulators; (3) country carriages weighing *under* 30 cwt., including accumulators. The following routes have been selected:—(*a*) London to Brighton, (*b*) Brighton to London, (*c*) London to Sandown and back, (*d*) London to Windsor and back, (*e*) London to Ascot and back, (*f*) special route for observations. Special optional routes will be selected for town carriages. In order to enable the Trials Committee to make efficient arrangements for the charging of cars, manufacturers of electric carriages are requested to inform the club secretary how many cars they propose to enter in the trials, and to state in respect to each car:—(*a*) The charging voltage at the beginning and end of charge, (*b*) the average current during charge, (*c*) the approximate time required for charging. Official entry forms will be issued in due course together with full programme of the trials. We may mention that statements of the particulars now asked for do not bind manufacturers to enter the cars for the trials.

Electric Train Lighting in Germany.—The minister charged with the control of the State railways in Germany recently ordered trials to be made with a simplified system of electric illumination. These experiments appear to have given favourable results, for on March 21st the system was installed on the train leaving Berlin for Sassnitz, and since that date numerous other trains have been fitted up with the system. The *Centralblatt f. Accumulatoren und Elementenkunde* of April 1st gives no details of the apparatus used, but it states that accumulators form an important adjunct of the system. We may therefore assume that it is our old friend the "Stone" system, modified by the utilisation of accumulator cells of German manufacture.

The Institution of Civil Engineers.—At the annual meeting of the Institution of Civil Engineers, held on Tuesday last week, Mr. Charles Hawksley, President, in the chair, the result of the ballot for the election of officers was declared as follows:—President, Mr. J. C. Hawkshaw, M.A.; vice-presidents, Sir William White, K.C.B., Mr. F. W. Webb, Sir Guildford Molesworth, K.C.I.E., and Sir Alexander Binnie; other members of Council, Mr. James Barton (Dundalk), Mr. Horace Bell, Mr. B. Hall Blyth (Edinburgh), Mr. Cuthbert A. Brereton, Mr. John Brown (Cape Town), Mr. R. Elliott Cooper, Colonel R. E. B. Crompton, Mr. Cecil West Darley, Mr. George F. Deacon, Mr. W. R. Galbraith, Mr. E. P. Hannaford (Montreal), Mr. G. H. Hill, Mr. J. C. Inglis, Mr. G. R. Jebb (Birmingham), Dr. Alex. B. W. Kennedy, Sir William Thomas Lewis (Cardiff), Mr. J. A. McDonald (Derby), Mr. William Matthews, C.M.G., Mr. William Shelford, C.M.G., Mr. Alexander Siemens, Mr. Henry C. Stanley (Brisbane), Mr. John Strain (Glasgow), Mr. John I. Thornycroft, Prof. W. C. Unwin, B.Sc., Mr. F. R. Upcott, C.S.I., Sir Leader Williams (Manchester).

The Light Railways Convention in London.—It has been arranged that the Berners Hall, Agricultural Hall, Islington, shall be the headquarters of the Tramway and Light Railway Congress, which will be formally opened on Monday afternoon, June 30th. The Tramways Exhibition will be opened immediately after the opening of the Congress. In the evening of the 30th a reunion or conversazione will be held, when those invited will be the joint guests of the Union Internationale Permanente de Tramways and of the Tramways and Light Railways Association. On the three following days, July 1st, 2nd and 3rd, Congress meetings will be held at the Berners Hall in the forenoon, and excursions will be made in the afternoon. On Friday, the 4th, the Congress will sit until they complete their labours, and in the evening a banquet will be given by the Association at De Keyser's Hotel. There will be a General Committee Room during the Congress at De Keyser's Hotel.

London County Council.—At a meeting on Tuesday the Council decided to lend £2,200 to the Poplar and Stepney Sick Asylum Managers for installing the electric light at the asylum.

The Parliamentary Committee, in reporting on the Council's General Powers Bill, referred to the clauses relating to the wiring and fitting of premises for electric lighting. It appeared that a question arose on the Bill before it reached the Select Committee as to the provisions proposing to enable local authorities to borrow and expend money for these purposes. These powers were sought at the request of the Borough Councils, but at the instance of the authorities of the House, the provisions were struck out of the Bill.

Mr. G. H. Radford, replying to Mr. W. Bruce, who asked the reason for the abandonment of the clauses, stated that the provisions were prepared at the wish of certain Borough Councils which were interested in the matter. The Council supported its case by citing instances of a number of other public bodies which had obtained private Acts which enabled them to do what the Borough Councils desired, and the Committee had done their best to advance the proposals.

The Highways Committee reminded the Council of the decision arrived at last February to acquire certain property at a cost of £70,000. The property, which was, until recently, used by the Gas Light and Coke Company, is known as the Pimlico Gasworks, has a river frontage of 320 ft., and is situated between Grosvenor Road and Pulford Street. In the opinion of the tramway manager and the electrical engineer, the site was suitable for a power station to supply energy for the working of tramways in the western half of the county. The Council's agent had entered into a formal contract for the purchase of the property for £80,000, and subsequently assigned the contract to the Council, whose solicitor was now in direct communication with the company for the completion of the purchase. On the recommendation of the Committee, the Council sanctioned a supplementary estimate of £11,000, so as to carry the scheme into effect.

It was decided to enter into a contract with Messrs. J. G. White and Co., the contractors for the roadwork, for laying the stoneware ducts for the electric cables to be placed within or alongside the footpaths near the tracks of the Westminster—Tooting tramways. The estimated cost of the works amounted to £10,000, including the repaving of the footpaths.

The Electrical Trades Section of the London Chamber of Commerce.—The annual report for the year 1901, relating to the work of the Electrical Trade Section of the Chamber during that period, states that 18 meetings of the Section and its committees were held in connection with a number of important questions affecting the electrical industry. The report refers to the action of gas and water companies in endeavouring to upset the settlement of the joint committee in regard to the question of "earth returns."

Having regard to the efforts of the gas and water companies to disturb this decision, the Section and its committee co-operated with the Tramways and Light Railways Association, and organised a deputation to Lord Morley, consisting of members of the two bodies. There were also in attendance to support the views of the traction companies the town clerks of Dundee and Sheffield. This deputation put the whole case of the tramway companies before Lord Morley, and there is reason to suppose that the lord chairman made representations to subsequent committees, since the decisions from that time have been sympathetic to the electrical traction industry. In the case of the West London Tramways there was a very favourable verdict from traction companies' point of view. The committee of the Section is still taking joint action with the Tramways and Light Railway Association on this matter.

In February the Section appointed an "Electrical Power Mains Regulations" Committee which arrived at the conclusion that an effort should be made to procure some modification of the existing Board of Trade regulations, and their views were embodied in a letter which was sent to the electrical adviser to the Board of Trade, which has already been published in our columns.

After referring to work done in connection with the power schemes, the report says that in May the Section appointed a sub-committee, consisting of the chairman and Major-General C. E. Webber, to represent the views of the Section on Clause 45 of the

Factory and Workshops Amendment Bill, wherein it was sought to include electrical stations and places where electrical energy was "transformed" within the scope of the Factory Act as non-textile factories. The matter was argued before the Standing Committee on Trade by Mr. Seton Karr, M.P., on behalf of the electrical industry, and further representations on the subject were addressed to Mr. Ritchie by the Section, jointly with the Institution of Electrical Engineers. The Electrical Section were represented on the Parliamentary Committee of the Manufacturers' Section, and, as a result of their joint efforts, some alteration was effected in the Bill. The Act as now passed contains the following addition to the list of non-textile factories:—"Electrical stations, that is to say, any premises or that part of any premises in which electrical energy is generated or transformed for the purpose of supply by way of trade, or for the lighting of any street, public place or public building, or of any hotel, or of any railway, mine, or other industrial undertaking." The clause is decidedly less objectionable than that originally drafted, because, (*a*) it is clear that it is not intended to apply to transformer boxes in streets; (*b*) only that part of the specified premises where electrical energy is actually generated or transformed will come within the Act.

Other matters considered by the Section included proposed the reduction of the maximum price for electrical energy; interruption of telegraphic communication between London and the North; appointment of the Board of Trade Departmental Committee on Light Railway and Tramway Legislation; the agreement between the National Telephone Company and the Post Office, &c.

Conversazione of the Institution of Electrical Engineers.—It has now been definitely announced that the Institution Conversazione will be held in the Natural History Museum on Tuesday, July 1st. In view of the fact that the Tramways and Light Railways Congress will then be sitting, and that many of the foreign delegates to the Congress are likely to attend the Conversazione, and that the Incorporated Municipal Electrical Association will also open its Convention in London on the following day, and, further, that the date is within a week of the date of the Coronation, when London is expected to be very full, the Council has decided, by permission of the trustees, to open one of the large side galleries in addition to the Central Hall of the Museum. The Metropolitan District Railway has, we understand, also kindly promised to open the subway from the South Kensington Station to the grounds for the benefit of guests travelling by this line.

Cork Exhibition.—At the Cork Exhibition the electric installation is of an extensive nature, practically all the machinery throughout the whole buildings being driven by electric power. The generating station is situated in the north-east corner of the Machinery Hall, and comprises two large Lancashire boilers working at 160 lbs. pressure, fitted with Meldrum patent automatic Koker stokers, and from these steam is conveyed by pipes to Laval steam turbines, Robey verticals, and Reavell vertical engines are coupled up to electric generators. The pressure on the external circuits is indicated on a Kelvin illuminated-dial station voltmeter; the board was built locally by Messrs. Porte & Co., of Dublin and Cork. The general illumination of the buildings is by means of about 100 enclosed type arc lamps, made by Crompton & Co. The stalls are all being lighted with incandescent lamps, of which there are several thousands in use. There are about 50 electric motors provided for driving the various exhibits requiring power.

The makers represented are the Brush Company, Crompton & Co., British Thomson-Houston Company, British Schuckert Company, Verity's (electric motors), Holmes & Co., and the Anglian Company. The electrical work in connection with the Cork Exhibition has been carried out by Messrs. Porte & Co., who are the sole electrical contractors, under the personal supervision of Mr. F. C. Porte, local manager of the firm. The whole of the engineering work has been carried out under the supervision of Mr. Cutler, C.E., city engineer, assisted by Mr. Nalder, chief engineer to the Cork Tramway and Lighting Company.

Calcium Carbide as an Insecticide.—During the past two or three years the vineyards in the well-known district of Beaujolais, in France, have suffered severely from the attacks of numerous winged pests, the most important of which is the pyralid (*Aphomia colonella*). The destruction became so great that last July a series of experiments was carried out in the Liergues vineyard to see if the perfect insects could be caught by means of bright lights burning all night. A little apparatus was constructed consisting of an acetylene generator holding about 6 ounces of calcium carbide, over it being a circular metal dish 18 or 20 in. in diameter, and over that at a height of 5 to 8 in. a single acetylene jet giving a light of about 10 C.P., which the carbide was sufficient to supply for six or seven hours. In the basin a layer of water 1 in. deep was placed, and on that a layer of petroleum or some other cheap oil, of which some two to five fluid ounces were required. These apparatus were erected at a distance of 150 yds. apart, and were set in action at dusk, preferably on dark nights. On the first night one lamp caught 4,650 pyralids and 218 odd moths; while on a later occasion when 20 lamps were employed, the catch varied from 900 to 5,000 in each; a total of 64,000, or an average of 3,200 insects per lamp per night. From July 13th to 31st, when the experiments were stopped, the total take was 170,000, or 940 per lamp-night; the proportion between the sexes being 42 per cent. of females and 58 per cent. of males. On the second and third nights (July 14—16th) the females were 59 per cent. and 76 per cent. of the take. The expense of the lamps is reported to have been 8 centimes per night, or 32 centimes per hectare (2·5 acres). This method of destroying insect pests is more efficacious than anything which has been tried before; simple basins of oil have caught many moths in the past; but the addition of the acetylene flame makes the trap far more powerful. The process, however, must be adopted at the time when the perfect insects are in existence, and when the weather is favourable—say, for about 20 nights in the year. The figures given above would have been even more satisfactory had the experiments been begun earlier in the season.

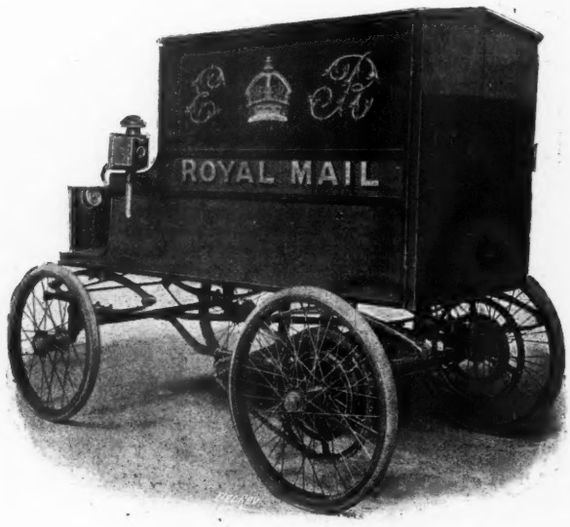
Institution of Electrical Engineers.—The Dublin branch of the Institution has elected the following gentlemen on to the Committee for the ensuing session:—Chairman, Mr. J. W. Towel; Vice-Chairman, Mr. F. Gill. Committee—Prof. W. F. Barrett, F.R.S.; Messrs. W. Brew, W. Brown, A. T. Kinsey, H. L. Edward, C F. Pilditch, A. E. Porte, P. S. Sheardown, W. Tatlow, and Prof. W. E. Thrift.

Royal Institution.—At Monday's meeting among the new members elected were Mr. Carl F. von Siemens, and Mrs. C. F. von Siemens.

Conference with Reference to the Factories and Workshops Act, 1901.—The Institution has issued invitations for this Conference at 3.30 p.m. on Monday, May 12th, in the rooms of the Society of Arts, kindly lent for the occasion.

Coronation Energy.—West Hartlepool. Mr. H. F. Fredericks. Replies to questions:—(1) None. (2) Free for one night to consumers. (3) No. (4) Municipal buildings, town hall, public market, and park entrances.

An Electrical Van for the G.P.O.—Mr. Carl Oppermann, of Wynnat Street, Clerkenwell, E.C., has lately completed an electric delivery van to the order of Messrs. Julius Harvey & Co. The vehicle, of which an illustration is given herewith, is intended for the G.P.O, and is to be used in the collection of letters from street boxes, and the conveyance of the same to the sorting office, the carrying capacity being about 10 cwt. The underframe is of tubular construction; it carries a 3-H.P. electric motor, driving the balance-geared counter-shaft by single-reduction spur



gearing, two side chains conveying the power to the rear road wheels. The battery, which is located under the driver's seat, consists of 40 cells of the new "A B C" accumulators of 160 ampere-hour capacity, stated to be sufficient to run the vehicle a distance of about 70 miles on one charge. The controller is adapted to give three forward speeds, the maximum being about 12 miles per hour. The steering is controlled by means of a tiller lever, while on the hubs of each of the gear road wheels, are pedal-actuated band brakes.

American Battery Combine.—A Philadelphia dispatch to New York *Electricity* says that a company under the title of the Consolidated Storage Battery Company, with a capital of $10,000,000, has secured a charter at Trenton, and it is believed that it is organised for the purpose of securing control of the various storage battery companies.

Germany.—In connection with the Düsseldorf International Exhibition, an International Navigation Congress is to be held in that city from June 29th to July 5th next. Among the many papers to be read are one on "Utilisation of Water-Power at Weirs," and one on "The Employment of Electricity on Inland Waterways and Harbours in Russia."

Electric Barges.—There is an effort being made to revive the scheme for widening and deepening the Severn and the Birmingham and Worcester Canal, so as to form a continuous water route for vessels of 300 tons burden from the Midland metropolis to the sea. An important feature of the scheme is the proposed introduction of steel barges worked by electricity.

General Post Office.—Mr. J. Hookey, late engineer-in-chief to the Post Office, has been presented with a handsome service of silver plate, subscribed for by numerous friends and colleagues in the service from which he has lately retired.

Obituary.—We regret to learn from the *B. and S. A. Export Gazette* of the death, at Kimberley, of Mr. Granville Vines, electrical engineer to the Kimberley Corporation. Mr. Vines was a valued and frequent contributor to our columns. The cause of death was enteric fever.

Personal.—Among the candidates recommended by the Council of the Royal Society for election into the Society, we note the names of Mr. John Brown and Mr. Thomas Mather. Mr. Brown is distinguished for his studies of the results produced by dissimilar substances on electric currents. Mr. Mather, who has for many years occupied the position of chief assistant to Prof. W. E. Ayrton in the City and Guilds of London Institute's Technical Colleges, has acquired distinction by virtue of his excellent work in the theory and practice of electrical engineering. Combining the qualities of painstaking, thoroughness, and foresight, with absolute devotion to duty regardless of self, Mr. Mather has unobtrusively carried on work of abiding value; probably the narrow moving-coil galvanometer (which he completely re-organised), the universal shunt box, and the electrostatic voltmeter, all of which were jointly devised by Mr. Mather and Prof. Ayrton, are the best known results of his labours. Our congratulations will be echoed by the army of past students who look back with gratitude to their association with Mr. Mather.

Mr. John Roberts, electrical engineer of Johannesburg, was lately married at St. Mary's Church there, to Miss Kate Brunkell.

Mr. F. Harrison, A.M.I.E.E., has resigned his position as works manager to Cryselco, Limited, Kempston.

Mr. S. Thos. Pemberton, late representative for Messrs. John Gibbs & Sons, Liverpool, has been appointed representative for the Midlands and South Wales for Electromotors, Limited, Manchester.

We learn that Mr. Venning, who has been the chief engineer of the steam engineering and central station department of the British Thomson-Houston Company, Limited, during the past five years, has resigned his position with that company. He is best known as the designer of several of the largest and most important generating stations erected during that time, his latest work being in connection with the plants of the Great Northern and City Railway and Chatham Tramways, both of which are nearing completion.

Mr. Walter Press has been appointed mechanical draughtsman in the first class, at a commencing salary of £215 a year, on the permanent staff of the head office of the London County Council Tramways. There were 56 applicants for the position.

From newspaper telegrams, and from the columns of American journals, we learn that Lord Kelvin is having a most magnificent reception wherever he appears in the United States. The ceremony of conferring upon his lordship the degree of LL.D. at Yale University is reported to have been most impressive. Lord Kelvin was expected to set sail for home to-day.

The Halifax Town Council have appointed Mr. Lionel E. Harvey, of Leeds, as superintendent of the tramways overhead construction work.

The chairman of the Bradford Tramways Committee (Mr. Jas. Hill), and the general manager (Mr. C. J. Spencer), are at present on a tour in the United States to inquire into tramway developments there.

Shipley Tramways.—The Shipley tramway was opened on May 3rd to run in connection with the line from Bradford to Frizinghall.

The B.A. Meeting.—This year's British Association Congress is to be held at Belfast from September 10th to 17th, under the presidency of Prof. James Dewar, F.R.S. Section A (Mathematical and Physical Science) will be presided over by Prof. J. Purser; G (the Engineering Section) being in the hands of Prof. J. Perry.

Expiring Patent.—It is of interest to point out that on the 1st inst., Patent No. 6,481, 1888, expired. This was the patent taken out by Tesla for the polyphase induction motor.

Appointment Vacant.—The Victoria Jubilee Institute vacancy to which we referred last week, is a Bombay appointment.

THE CENTRAL STATION ENGINEER.

The Cheltenham B.C. has increased the salary of the borough electrician, Mr. Hamilton Kilgour, from £400 to £500.

Mr. W. T. Stamp has been appointed chief assistant to the electrical engineer at Devonport, at a salary of £130 a year.

Mr. F. C. Pay, the electrical engineer at Newton Abbot, where the Edmundson Corporation, Limited, are about to lay down their plant, was presented by the staff and employés at Hammersmith Borough Electricity Department with an oak case of drawing instruments, &c., on his leaving that place for Newton Abbot.

On Friday afternoon, 2nd inst., Mr. J. Gray Scott was presented by the staff of the Corporation electricity department, Leith, with a handsome smoker's cabinet, on the occasion of his leaving to take up his appointment as borough electrical engineer, Croydon. Mr. A. Peden Rutherford, who is to succeed Mr. Scott at Leith, made the presentation, and in the course of a few remarks, said that he hoped Mr. Scott would look upon the gift as a mark of their great appreciation of the courtesy he had always shown towards the staff. Mr. Scott, in returning thanks, referred to the success of the undertaking in Leith, and said that he felt that this success was due to a large extent to the hearty co-operation of the members of the staff with himself.

Recently in Cape Town the Electric and Waterworks Committee reported to the Borough Council that they had invited applications, both in England and in South Africa, for the position of electrical engineer, at a salary of £650 per annum, with free residence, the agreement to be for three years. In the result, 73 applications were received in London, and nine in Cape Town. After some discussion, the matter was put to the ballot, and the Council duly elected Mr. W. F. Long, of Manchester.

The engineering staff and employés of the Glasgow Corporation Tramways held a smoking concert on Monday, April 28th, at the Bank Restaurant. Mr. William Clark, the engineer-in-chief, presided. During the evening Mr. M. B. Field made a presentation to Mr. J. W. Donnet, the power station superintendent, on the occasion of his leaving Glasgow to take up a position as resident engineer to the Trafford Park Power and Lighting Supply Company. The presentation consisted of a gold watch and chain, and a gold bracelet for Mrs. Donnet.

NEW COMPANIES REGISTERED.

Electro Voelker Syndicate, Limited (73,551).—This company was registered on April 25th, with a capital of £5,000 in £1 shares, to carry on the business of sanitary and electrical engineers, gasfitters, &c., and to adopt an agreement with A. Manning. The first subscribers (each with one share) are: E. B. Morris, The Hawthorns, 54, Pelham Road, S. Wimbledon, S.W., clerk; W. B. Saw, 25, Holwood Road, Bromley, Kent, accountant; J. M. Cook, 76, Corrance Road, Brixton, S.W., clerk; J. R. Beckett, 57, Cambridge Road, Ilford, gentleman; H. E. Hounsell, J.P., 6, Bellefields Road, Brixton, S.W.; T. J. V. Fielden, Winchester House, Watford, gentleman; and A. Roe, 58, Linthorpe Road, Stamford Hill, N., gentleman. No initial public issue. The number of directors is not to be less than two nor more than three; the subscribers are to appoint the first.

Bohm Syndicate, Limited (73,577).—This company was registered on April 29th, with a capital of £35,000 in £1 shares, to acquire from M. Boyd the benefit of certain existing inventions relating to electric incandescent lamps, and to carry on the business of electricians, engineers, suppliers of electricity for light, heat and power, manufacturers of and dealers in electric lamps and apparatus, &c. The subscribers (each with one share) are:—E. Bohm, 46, Clerkenwell Road, E.C., electrician; A. J. Prout 60, Fore Street, E.C., stockbroker; C. E. Daniel, 48, Atholl Mansions, South Lambeth Road, S.W., civil engineer; H. M. Cox, 28, Martin's Lane, E.C. contractor; F. J. Evans, Blue Anchor Tavern, Fenchurch Street, E.C., licensed victualler: W. M. Bailey, Woodleigh, Forest Hill, S.E., accountant; and M. Boyd, 147, Fenchurch Street, E.C., financial agent. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; remuneration, two guineas each per board meeting attended (three guineas for the chairman).

Receiver Syndicate, Limited (73,571).—This company was registered on April 28th, with a capital of £2,000 in £1 shares, to acquire and turn to account patents, concessions and rights relating to wireless telegraphy or telephony and apparatus connected therewith, and to deal in and with apparatus, machinery, &c. The first subscribers (each with one share) are:—T. Andrew, 8, Sheen Park, Richmond, gentleman; F. R. Bristow, Stock Exchange, E.C., stockbroker; R. M. Kerrell, 9, Gracechurch Street, E.C., gentleman; F. A. Jessett, 67, Leadenhall Street, E.C., merchant; G. C. A. Kohler, 74, Wool Exchange, E.C.; merchant; H. Saunders, 8, Great Winchester Street, E.C., gentleman; and W. Timbrell, 75, Queen Victoria Street, E.C., journalist. No initial public issue. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Morley Electrical Engineering Company, Limited (52,358).—This company's annual return was filed on March 17th, when 1,524 shares were taken up out of a nominal capital of £5,000 in 5,000 shares of £1 each; £1 per share has been called up on each of 504 shares, resulting in the receipt of £504; 1,020 shares are considered as fully paid. Mortgages and charges, £1,000.

London Electric Wire Company, Limited (36,544).—This company's annual return was filed on March 3rd, when 7,512 preference and 8,295 ordinary shares were taken up out of a nominal capital of £100,000 in 10,000 preference and 10,000 ordinary shares of £5 each; £5 per share has been called up on 3,652 preference and 4,495 ordinary shares, resulting in the receipt of £40,435; £38,600 is considered as paid on 3,860 preference and 3,860 ordinary shares. No mortgages or charges.

Kensington and Knightsbridge Electric Lighting Company, Limited (26,193).—This company's annual return was filed on March 24th, when 21,000 ordinary, 10,000 first preference, and 10,000 second preference shares were taken up out of a nominal capital of £350,000 in 50,000 ordinary, 10,000 first preference, and 10,000 second preference shares of £5 each. £5 has been called up on each of 15,968 ordinary, 10,000 first preference, and 10,000 second preference shares, resulting in the receipt of £179,840. £25,160 is considered as paid on 5,032 ordinary shares. Debt in respect of mortgages and charges, £9[illegible],000. Ditto in respect of debenture stock issued by this company in conjunction with the Notting Hill Electric Lighting Company, Limited, £115,000.

Scarborough Electric Supply Company, Limited (37,569).—This company's annual return was filed on March 9th, when 6,000 shares were taken up out of a nominal capital of £100,000 in 10,000 shares of £10 each. £9 per share has been called up on 5,000 and £6 per share on 1,000 shares, resulting in the receipt of £50,993; £7 remains in arrears. No mortgages or charges.

Mazarron Electric Light Company, Limited (38,277).—This company's annual return was filed on February 3rd, when 151 preference and 10,000 ordinary shares were taken up out of a nominal capital of £15,000, in 500 preference shares of £10 each and 10,000 ordinary shares of £1 each. £10 per share has been called up on 151 preference, and £1 per share on seven ordinary shares, resulting in the receipt of £1,517. 9,993 ordinary shares are considered as fully paid. Mortgages and charges, £820.

Northampton Electric Light and Power Company, Limited 28,640).—Particulars of registered mortgages and charges:—

Amount secured.	Dates of resolution creating series of debentures.	Dates and amounts of issues.	Property charged.	Trustees.	Amount previously issued in same series.
		1901.			
£8,600.	Dec. 6, 1898, and Mar. 8, 1891.	March 8, £5,000.	The undertaking and property of the company, present and future, including uncalled capital.	None.	£3,600.
Not exceeding two-thirds of the subscribed capital for the time being.	June 3, 1896.	April 15, £700. July 1, £200 Aug. 31, £200. Sept. 28, £1,800. Oct. 11, £700. Oct. 25, £1,000. Nov. 26, £450. Dec. 31, £400. 1902. Feb. 15, £1,450. March 3, £450.	Ditto.	None.	£19,500.

St. James's and Pall Mall Electric Light Company, Limited (20,015).—This company's annual return was filed on March 20th, when the entire capital of £300,000 in 20,000 preference shares and 40,000 ordinary shares of £5 each had been taken up. £5 per share has been called up on 20,000 preference and 39,650 ordinary shares, resulting in the receipt of £298,250. £1,750 is considered as paid on 350 ordinary shares. Mortgages and charges £150,000 (3½ per cent. debenture stock).

Pontypool Electric Light and Power Company, Limited (36,109).—This company's annual return was filed on April 8th, when 1,143 shares were taken up out of a nominal capital of £10,000 in 2,000 shares of £5 each; £5 per share has been called up on 669 and £4 per share on 474 shares, resulting in receipt of £5,241. Mortgages and charges, £5,000.

Notting Hill Electric Lighting Company, Limited (25,921).—This company's annual return was filed on April 11th, when 10,852 ordinary, 2,998 ordinary preference and 550 founders' shares were taken up out of a nominal capital of £200,000 in 16,452 ordinary, 2,998 ordinary preference and 550 founders' shares of £10 each; £144,000 has been received. Mortgages and charges, £50,000. Ditto, issued jointly by this company and the Kensington and Knightsbridge Electric Lighting Company, Limited, £115,000.

CITY NOTES.

Calcutta Electric Supply Corporation.

Col. A. J. Filgate, R.E. (Chairman), presided on Thursday last week at Winchester House over the 5th annual meeting of the above company, and in moving the adoption of the report, said that the business continued to grow at a more rapid rate than they ever expected, and was apparently likely to continue to largely expand. In order to meet this expansion they had had to incur considerable expenditure, and their commitments for further outlay were also considerable. During the last year they expended £63,372, and the total capital outlay at the close of the year reached £180,639. They had expended £4,038 on land and buildings, chiefly in connection with the new station at Alipore; £12,067 under machinery and tools; this included two Babcock and Wilcox boilers, one 225-kw. steam dynamo, two 38-kw. sets for Alipore, extensions of steam pipes and switchboard, and two Green's fuel economisers. With regard to the £37,022 on mains, it was difficult to describe the outlay under this head. It consisted of large consignments of Callender's cable of various sizes, overhead bare copper, posts, &c., and the cost of placing these materials in position. The total length of mains laid at the end of the year was:—Underground feeders and distribution mains 22½ miles, overhead feeders and distribution mains, 23½ miles, altogether 46 miles of mains. At the end of 1900 they had 26 miles of mains, so it would be seen they had added 20 miles of feeders and distribution mains to their system during the year. These were large figures but they were fully justified by their progress, and they were sending out a considerable further addition of mains material. They had expended £5,218 on meters due to the number of installations having increased from 488 to 880, and the outlay on fans had been £2,740. Their present plant at Emambagh Lane was:—two 38 kw. sets, and three 225-kw. sets, and they had under supply, one 228-kw. set, and two 750-kw. sets. At Alipore they had two 38-kw. sets, and two 115-kw. sets removed from Emambagh Lane, and had under supply for this station two 228-kw. sets. The Alipore station commenced to supply electricity on March 1st, and it was expected that this station would add considerably to the business, and would also help in strengthening supply at the Southern end of the district they had hitherto dealt with from Emambagh Lane. It seemed probable that the growth of the business would soon necessitate the building of a third station at the north end of the City, and their agents were now looking out for a suitable site. If they obtained the order for supplying Howrah, this might entail the erection of a fourth station on the Western side of the Hoogley. They were receiving frequent demands for further extensions of mains to meet new customers, and had large supplies of cable under order. This all meant considerable outlay of fresh capital, but the demands were carefully investigated by their agents in India and by the board in London, and they had every confidence that the additional outlay would prove remunerative and help them to pay satisfactory dividends. During the past year they found themselves obliged to issue 10,000 new shares at a price of £6 each, and the premium on this issue, £10,000, had been added to the reserve fund, which now stood at £15,000. With the £2,500 set aside last year for depreciation and renewals, they had started a renewal fund account, against which the expenditure on repairs and maintenance, as well as the outlay on spare parts of machinery, would be charged. They had added to this account a further sum of £5,000, and had debited against this the outlay during 1901; £700 of this outlay represented the value of spare parts of machinery, a large portion of which was in store ready for any emergency. The net result was that they now had £5,590 at the credit of the account, and the total amount of the two reserve funds was £20,590. The units sold during the year reached 962,958, compared with 412,950 in 1900, a satisfactory increase. They received 562 applications for current, compared with 445 in the previous year, and the lamps and motors connected to the system at the end of December amounted to an equivalent of 58,284 8-c.p. lamps, against 28,748 at the close of 1900. This large increase, no doubt, was in some measure due to the revised scale of rebates introduced last year, which placed large consumers on more favourable terms, and they believed the course they had adopted would bring them increased work. The gross revenue for the year had amounted to £23,248 as compared with £11,147 in 1900. The expenditure in the year reached £14,602, including the sum already alluded to of £5,000 for maintenance and renewals, against £8,252, which included £2,500 set aside for maintenance and renewals in 1900. They proposed to pay a final dividend for the half year at the rate of 7 per cent. per annum, making, with the interim dividend, 6 per cent. for the year, and carry the balance, £392, forward. They had had some trouble during the year by the breaking down of some of their underground mains. After considerable discussion Messrs. Callender agreed to send out Mr. James Callender to investigate the cause of the failures, and about the same time the directors availed themselves of the services of Mr. A. H. Preece, who was then in India, to report generally on the company's system, and also to investigate the cause of the failures in the mains. The reports as to the causes of the breakdowns were still under the consideration of the experts, but there was little doubt that the result of the investigations would place matters on a better footing. There was, however, no manner of doubt that the climate of Calcutta, and the heavy storms experienced there, must tend to make it more difficult to keep works like theirs in proper order than was the case in connection with similar undertakings in England. He had no doubt, however, that means would be found to meet such difficulties. Mr. Preece's general report on their system was satisfactory, and he spoke in high terms of the staff. The reports they received each mail of fresh applications for supply were most encouraging. The use of fans had largely increased, and fans were reported to have been imported in large numbers for the present season. Attention was also being given to driving swinging punkahs mechanically by electricity. It was believed that this method would be adopted in some of the large offices. Their agents had been in treaty with the Eastern Bengal State Railway for supplying the station and offices at Sealdah, and a considerable day load was expected for working electric cranes and motors in the Port Commissioners' tea warehouse. Everything pointed to their having a large increase in the business in the immediate future, and to meet this they must be prepared to expend a considerable amount of capital. From January 1st up to April 4th the lamps and motors on the system showed an increase of the equivalent of 8,020 8-c.p. lamps, while the increase in the same period of last year was 7,106 8-c.p. lamps. Further, the units delivered to customers this year up to that date amounted to 266,333, against 160,548 up to April 1st, 1901.

Mr E. Boulnois, M.P., seconded the motion, and it was agreed to.

Submarine Cables Trust.

The Marquis of Tweeddale presided at the annual meeting of certificate holders, held on Tuesday, May 6th, at Electra House, Moorgate, E.C., the new offices of the cable companies. He moved the adoption of the following report:—

The accounts for the financial year, to April 15th, 1902, are submitted herewith. The revenue for this period amounted to £24,615 0s. 4d., and the expenses to £1,250 19s. 4d., leaving a balance of £23,364 1s., to which is added the sum of £44 9s. 5d., brought forward from the last account, making an available balance of £23,408 10s. 9d. After providing £19,725 to meet payment of the coupons, the sum of £ ,611 19s. has been transferred to the redemption fund, leaving a balance of £71 11s. 5d. to be carried forward to the next account. In accordance with the terms of the trust deed 31 certificates have been redeemed, since the last report, by the purchase in the open market, costing £3,611 19s. as above. The trustees much regret to report the death of their colleague, the late Clement S. Colvin, Esq., which took place at Cintra, near Lisbon, in August last.

After the chairman had made a few observations regarding the business of the trust, Sir J. Denison Pender seconded the adoption of the report, which was carried unanimously, and the auditors were re-elected.

West Coast of America Telegraph Company.

Sir J. D. Pender presided on Tuesday at the meeting held at Electra House, E.C., and in moving the adoption of the report, said that the accounts for the past few years showed that there had been a steady increase in the company's receipts, though the increase of 1901 over 1900 had not been in the same ratio as in former years, but that was not through any loss of traffic, it was accounted for by the reductions in April last year. The working expenses were very much the same for both years. As to cable interruptions the Molendo cable was down from June 3rd to June 9th, and the Arica cable

from September 14th to September 29th. The cost of cable repairs had been pretty much the same. Fourteen knots of cable had to be put into the Arica cable in November, and as they worked pretty well from hand to mouth to keep down expenses, they had afterwards to replenish their stock of cable there. He was in hopes that he would be able to say that the ship had not been called upon for any work this year up to the present date, but a message had come that very morning to say that the Molendo-Arica cable was interrupted, and that the ship had already left for its repair. The difference between receipts and expenses was £9,672; debenture interest took £6,000, income bonds £800 for interest, and £1,500 had been placed to general reserve. They had also placed £1,000 to maintenance ship's reserve fund. The ship stood on the books at £10,000, which they considered a full value for her, therefore, instead of writing down that amount, they had put the sum of £1,000 to reduce the value of the ship and also to be used in case of any special expenditure for maintenance. The £1,500 was the starting of a general reserve, to which he hoped they would be able to add every year, to replace the cables as they became too old to work.

The motion was adopted, and the retiring director and auditors having been re-elected, the meeting closed with a vote of thanks to the board and staff.

Castner-Kellner Alkali Company.

The report for the year ended March 31st states that the net profit is £68,319; to this has to be added the amount brought forward, making a total of £70,586. The directors recommend that £15,000 be appropriated to depreciation reserve, increasing that account to £40,000; that the whole of the amount standing to suspense account (law suits), £6,102, and £4,938, expenses and costs of amalgamation, together £11,040, be written off; and that a dividend at the rate of 8 per cent. per annum be paid for the six months ended March 31st, making, with the interim dividend paid in November last, 6 per cent. for the year, leaving £6,589 to be carried forward.

Western Telegraph Company.

The directors' report for the half-year ended December 31st, 1901, to be submitted to the meeting, May 14th, reads as follows:—

The directors submit the annexed accounts and balance-sheet for the half-year ended December 31st, 1901. The revenue for this period amounted to £221,512 9s. 1d., and the working expenses to £101,002 19s. 4d. After providing £9,576 3s. 10d. for debenture interest and sinking fund, and £4,391 19s. 2d. for income-tax, there remains a balance of £106,541 6s. 9d.; to this is added the sum of £3,368 14s. 9d. brought forward from June 30th last, making a total of £109,910 1s. 6d. First and second interim dividends, amounting to £62,379 have been paid, and after transferring £40,000 to the general reserve fund, and £2,000 to the maintenance ship's reserve fund, there remains a balance of £5,531 1s. 6d. which is carried forward to the next account. The revenue includes £11,336 11s. 6d. dividends upon the company's investments in other telegraph companies. The International Telegraph Conference which was to have been held in London this month has been postponed until next year. Important renewals of the Para-Maranham and Pernambuco-Rio No. 1 cables were arranged for last autumn and have been completed during the current half-year. The cost of the new cable (£52,398) for these purposes is charged against the general reserve fund in the accounts now submitted.

West India and Panama Telegraph Company.

The directors' report for the half-year ended December 31st, to be submitted at the meeting on May 14th, reads as follows:—

The directors submit the accounts for the six months ended December 31st, 1901. The amount of credit of revenue is £25,243 16s., against £24,300 0s. d. for the corresponding half-year of 1900. The expenses have been £19,536 14s. 8d., against £20,962 14s. 1d., leaving a balance of £5,407 1s. 4d., to which is added £2,529 5s. 5d. interest on investments, and £6,512 6s., brought from last account, making a total of £14,448 12s. 9d. with which it is supposed to deal as follows —

Payment of 6s. per share on account of arrears of dividend on the first preference shares	£10,368	18 0
Balance to account half-year's account	4,079	14 9
	£14,448	12 9

This will leave in arrear the dividend on the first preference shares for the six months ended December 31st, and 18 months' dividend to the same date on the second preference shares. As compared with the corresponding period of 1900 there has been an increase in revenue of £943 15s. 11d., and a decrease in expenditure of £1,125 19s. 5d. The International Conference recently held in Brussels has decided, subject to ratification by the Powers concerned, to abolish foreign sugar bounties on September 1st, 1903. The abolition of these bounties is calculated to be very beneficial to all West India interests. The company's appeal to the House of Lords in the action brought against it by the Cuba Submarine Telegraph Company is expected to be heard in the course of current year.

Prospectuses.

The Bournemouth and Poole Electricity Supply has this week been before the public with an issue of 7,500 6 per cent. cumulative second preference shares of £10 each. The shares were offered by the Electric and General Investment Company, Limited, at a premium of £1 per share. The issue was made to provide funds for the further development of the business and to repay borrowed monies.

The subscription list was to close yesterday, Thursday, in an issue of 200,000 £5 preference shares at par in the Dunderland Iron Ore Company, Limited, which has been formed with a nominal capital of £2,000,000 to acquire and work extensive deposits of iron ore in Norway. Mr. Edison's magnetic separating treatment is to be employed, and a set of this machinery is said to be open to view at Balham, London, S W., on application to the secretary of the company. Mr. Edison, Lord Kelvin, Prof. Hy. Louis, of Newcastle, and Mr. J. E. Stead, F.I.C., are the company's technical advisers.

Kidderminster and District Electric Light and Traction Company.

Mr. W. L. Madgen presided over the fourth annual general meeting of the above company held at Donington House on Thursday afternoon, and in moving the adoption of the report, first referred to the death of Mr. D. F. Sugrue, who, he said, had done a great deal of work during his lifetime in connection with tramways matters. The company possessed powers authorising the general supply of electricity for lighting, power and other purposes in the borough of Kidderminster. The supply in the town was inaugurated in August, 1900. The company also held the share capital from the Kidderminster and Stourport Electric Tramway Company. Powers had been acquired for the extension of the tramways from the Kidderminster terminus through the town to the neighbouring borough of Bewdley, and on completion of this work the total length of the tramways in the town and district would be increased to close on 9 miles. The whole of the system would be operated from the present main power station at Kidderminster. Substantial progress had been made in both departments of the company's business during the past 12 months, and a number of important changes were shown in the items in the accounts. Taking, in the first place, the electric supply department of the company's business, which only commenced to connect consumers in the autumn of the previous year, the receipts from sale of current amounted to £2,747, as compared with £182 for the four months of 1900 during which the supply was available. At the present time the number of private consumers represented a demand upon the plant equivalent to 7,628 lamps of 8 c.p., as compared with 5,760 12 months ago. While this might be taken as equal to the normal rate of progress in the first year of electric supply business, they felt justified in looking forward to more rapid growth in the future. It would be seen from the capital account that they had expended £15,148 during the year, including £9,893 on new machinery. In the report for 1900 it was announced that this expenditure had been rendered necessary by the growing demand for current for power purposes, which was always a most desirable feature of an electric supply business. Kidderminster was a manufacturing town, and they were doing their best to bring the benefit of electric power driving to the notice of the manufacturers, and were offering facilities in the way of letting motors on hire or on the system of hire purchase. In America and Germany where the legislative restrictions were not so severe, electricity was largely used by manufacturers, and there was reason to believe its use had materially assisted them in competing with England. Those connected with the electrical industry had been working for years to remove the restrictions, and he began to hope they would be successful, and that their business would gain an impetus by the removal of these restrictions. On the other side of the capital account, an addition of £17,000 appeared in the item of ordinary shares, raising the total capital to £77,000. Of that amount £56,000—roughly, about two-thirds—was invested in the Kidderminster and Stourport Electric Tramway Company, from which they received in dividends £2,240, as compared with £1,540 in the previous year. This improvement was contributed to by greater economy in working, the proportion of expenses to receipts being reduced from 65 to 58 per cent. The route mileage remained at the same figure, but the Bewdley extension would very nearly double the length of the line, and would enable them to serve a population of about 45,000, favourably distributed for tramway business. The gross receipts from all sources, including the sum brought forward from the previous year's account, amounted to £5,819, as against £2,924 in 1900. The expenses were relatively larger, owing to the expansion of the business, but not proportionately larger, and the net profit of £2,339 compared favourably with £2,157 last year. They paid the full preference dividend of 5 per cent, and a dividend on the ordinary shares of 2 per cent. Without wishing to indulge in prophecy, he believed that next year the ordinary dividend would be larger.

Mr. J. S. Raworth seconded the motion, and it was agreed to without discussion.

New General Traction Company.

The report of this company, for the year ended March 23rd last, to be presented at the meeting on the 12th inst., states that the gross profits for the year were £53,064, after deducting £7,385, the amount of general expenses, salaries, directors' fees, interest on loans and legal expenses. Five per cent. interest on the company's outstanding mortgage debentures up to March 23rd, amounted to £5,678, leaving £47,386. The directors propose to write off £6,694, being the expenses, including underwriting, of the debenture issue of last July, and £166, being the loss in the price of Consols sold during the year; this leaves a balance of £40,526. To this has to be added £41,135 brought forward, making a total profit of £81,662. The directors recommend that £70,000 be applied to write off the balance of goodwill and that the balance, £11,662, be carried forward. During the year the directors offered for subscription £200,000 of 5 per cent. mortgage debentures, of which £181,300 were subscribed.

Primitiva Gas and Electric Lighting Company of Buenos Ayres.

The report for 1901, to be presented at the meeting on the 13th inst., shows balance of revenue account amounting to £30,444, and after deducting interest (which will not be incurred again), London expenses, remuneration of local board and income-tax, there remains a net profit amounting to £67,305, which, after paying interest on debentures, £14,534, leaves a sum available for dividend of £52,772.

Two dividends were paid for the past year of 2s. 6d. each on the preference shares, absorbing £40,000, leaving £12,772, which the directors propose to carry forward to new account. During the year a sum of £45,191 has been expended on capital account on improvements and extensions of mains, cables, &c., and on new electric plant and machinery, which has been rendered necessary in consequence of the increasing demand for electric lighting.

Willans & Robinson, Limited.

A GENERAL meeting of the holders of the first mortgage debenture stock was held last week at Westminster Palace Hotel, to consider an arrangement made between the company, of the one part, and Robert S. McLaren, on behalf of all the holders of the said debenture stock, of the other part, for the constitution of a new first mortgage debenture stock of the company of £250,000 bearing 4 per cent. interest, and for the acceptance by the holders of the existing debenture stock of the new debenture stock at the rate of £105 of the latter for £100 of the former stock. Mr. Mark Robinson, who presided, formally proposed the resolution, which was carried unanimously.

Stock Exchange Notices. — Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—British Westinghouse Electric and Manufacturing Company Limited. — £500,000 4 per cent. mortgage debenture stock. Electrical Distribution Company, Limited.—Ordinary shares of £10 each, fully paid; and 6 per cent. cumulative preference shares of £10 each, fully paid. The Committee has further been asked to allow the following security to be quoted in the official list:—Eastern Telegraph Company, Limited.—Further issue of £102,377 4 per cent. mortgage debenture stock.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending May 2nd were £724; corresponding week last year, £648: increase, £76. Total to date, £11,371; corresponding period last year, £9,955; increase, £1,416. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending May 3rd were £357; corresponding week last year, £360; decrease, £3. Total receipts to date, £4,246; corresponding period last year, £3,950; increase, £296.

Bristol Tramways and Carriage Company.—The receipts for the week ending May 2nd were £4,157: corresponding period last year (visit of Earl Roberts), £4,494; decrease, £337.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending April 25th:—

Company.	Amount	Comparison with corresponding week of last year.		No. of weeks.	Aggregate.		
					Amount.	Inc. or Dec.	
	£	+ £	− £		£	+ £	− £
Devonport*	398	—	—	16¼	6,337	—	—
Dudley–Stourbridge	683	36	—	16½	10,737	2 003	—
Gateshead*	691	—	—	16½	10,482	—	—
Greenock-Pt. Glasgow	450	245	—	16½	6,518	3,644	—
Hartlepool	252	33	—	16½	3 198	237	—
Kidderminster ..	103	—	13	16½	1,420	141	—
Merthyr‡	169	—	73	16½	3,133	—	367
Middleton*	261	—	—	4½	1,306	—	—
Oldham–Ashton ..	499	—	80	16½	7,715	—	1
Poole‡	260	11	—	16½	3,874	39	—
Potteries	1,489	67	—	16½	23,590	896	—
Southport	229	78	—	16½	2,833	704	—
South Staffordshire†	765	—	8	16½	11,984	595	—
Swansea	426	35	—	16½	6,774	649	—
Taunton*	59	—	—	16½	904	—	—
Tynemouth§	221	—	15	16½	3,362	144	—
Wolverhampton Dist.	143	88	—	16½	2,183	1,401	—

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. § Comparison from March 18th only.

Central London Railway.—The receipts for the week ending May 3rd were £6,987; corresponding week last year, £6,428; increase, £559. Total receipts to date, £119,796; corresponding period last year, £111,024; increase, £8,772. Miles open, 6.

City and South London Railway.—The receipts for the week ending May 4th were £2,920; corresponding week last year, £1,862; increase, £1,058. Total receipts to date (18 weeks), £53,457; corresponding period last year, £35,836; increase, £17,621. Miles open, 6½; last year, 4½.

Dover Corporation Tramways. — The receipts for the week ending May 3rd were £184 1s. 11d.; corresponding week last year, £199 7s. 10d.; decrease, £15 5s. 11d. Total to date, £8,189 0s. 2½d.; corresponding period last year, £8,070 13s. 3½d.; increase, £118 6s. 11d. Miles of track open, 8. Car miles run, 1902, 5,136; 1901, 5,071. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending May 2nd were as follows:—D.U.T. Co., £3,691 12s. 5d.; D.S.D. Co. £798 9s. 11d.; total, £4,490 2s. 4d.; corresponding week last year—D.U.T. Co., £3,645 12s. 3d.; D.S.D. Co., £854 6s. 9d.; total, £4,499 19s. 0d.; decrease, £9 16s. 8d.; aggregate to date, £72,422 9s. 7d.; last year, £68,924 0s. 6d.; increase, £3,498 9s. 1d. Mileage worked, 46.

Glasgow Corporation Tramways.—For week ending April 26th, £11,941 19s. 3d., compared with £10,112 16s. 11d. for same period in previous year. Aggregate since June 1st, 1901, £554,042 19s. 9d., compared with £430,109 19s. 6d. for corresponding period in previous year.

Liverpool Overhead Railway. — The receipts for the week ending May 4th were £1,399; corresponding week last year, £1,632; decrease, £233. Total to date £25,238; corresponding period last year, £27,551; decrease, £2,313. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

ALL the markets of the Stock Exchange are wistfully watching Vereeniging, and the results of the momentous conference shortly to be held at that little place are vainly attempted to be solved in every department. The House, as a whole, has set its heart on peace. Consols and the gilt-edged department are hard, and that notwithstanding the new Indian issue, the wild gambling in the New York money market, and a few bear sales. The Lombard Street merchants find rates for cash keep low, and are glad to get a seventh of the percentage demanded in some New York cases for short loans.

Sympathy with the investment markets is plainly apparent amongst electrical supply shares. Prices show small variation, although trade is by no means inactive. The fluctuations are really confined to a rise of 5s. in Edmundson's Preference (replacing the fall of last week), and a decline of similar amount in London Electric Preference. Metropolitans keep steady at 16; sharp is the issue between those who declare that the shares will go to 25, and the more prudent who consider the current quotation a very fair one. It is needless to remark that the whole question hinges upon the decision of the arbitrators in the Marylebone case. Between the two millions sterling demanded by the company and the three-quarters of a million offered by the Marylebone people there is ample scope for speculation. That some medium price will be fixed is the general theory.

Several additions have recently been made to the number of electrical supply shares quoted in the Stock Exchange Official List. Westminster new Preference are called 3½ to 4 for the £5 shares with only half that amount called up. Charing Cross and Strand new Ordinary are 8 to 9, £1 under the price of the senior shares. Central Electric 4 per cent. Debenture stock is negotiable about 107. In the Provincial section, Bournemouth and Poole are 11½ and 10 for Ordinary and Preference respectively. The company is making an issue of new 5 per cent. Preference shares at £11 apiece, and the emission will probably be received with thanks. Folkestone Electric Lighting shares are 6, Oxfords 5½, and Hove 7½. Going further afield, Calcuttas are quoted at £9 middle, and Primitiva Gas and Electric Lighting at 2½, for the fully-paid £5 share. Royal Electric, of Montreal, Debenture stock, stands at 103; Electric Lighting of Australia, Preference, at 4¼, while at 102½ the 5 per cent. Debenture stock is now *ex* dividend.

The famous Welsbach compromise has failed to advance to any extent the company's securities, the advantages to be gained from the cessation of litigation being offset in market opinion by the doubt which still hangs to the principal Welsbach patent, and the prospect of vastly increased competition.

No market is yet made in the shares of the South Wales Power Distribution Company, but the Stock Exchange took the prospectus rather kindly, recognising the restraint of flamboyant dividend expectations in the case of a concern which has all its spurs to win. The shares are, of course, a speculation, and one which time alone can prove.

The special settlement of the London United Tramways new issues proceeded smoothly enough this week, the Preference "making-up" price being 1 premium, 103½ Debentures, and 52¾ for the partly paid. In this connection it is amusing to note that the London United is making desperate efforts to get revocations of their signatures from householders in Barnes who petitioned against the company being allowed to bring its trams over Hammersmith Bridge. British Electric Tractions are steady, and Calcutta Trams a remarkably good market at 14⅜.

The telegraph department shows a variety of minor changes, which do not exceed a couple of points anywhere except as regards Submarine Cables Trust certificates, in which flatness is again accentuated. Eastern descriptions are irregular, the prior securities being harder, while Eastern Ordinary registers a fall of 2. Anglo-American Preferred, after being 90 bid, is still a point up on the week. Directs are a shade lower, but some of the West India and Panama issues have hardened on the assistance which the Government is now according to that distressful isle, Jamaica. Marconi shares are coming down to £3, all support being apparently withdrawn. Yet the shares have just been introduced to the Wall Street Stock Exchange.

City & South London stock at 71 is better, the traffics keeping very good, while the little snub over the Euston extension is not taken seriously. In fact, some in the market seem to think the company will be just as well off without the extension. The deliberations of the "Tube" Committees now sitting, are without any practical influence so far.

In the Miscellaneous List, Reuter's moved up ½ on Wednesday, but Edison & Swan Debentures are flabbily weak. As a speculative investment, these latter will soon be worth buying. Another large power company is being got ready in Yorkshire, and will probably be with us shortly after the Whitsun holidays.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations April 30th.	Closing Quotation May 7th.	Business done during week ended May 7th, 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	44 — 47 xd	44 — 47	44½	...
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	88 — 90	89 — 91	90¼	£9
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.	2s.	7 — 7½	7 — 7½	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	150 —160	150 —160	...	...
1,741,629£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	93 — 96	93 — 96	93½	...
16,000	Cuba Telegraph	10	7 %	...	...	4 — 5	4 — 5	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	2½— 3½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102 %	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9½— 10½	9½— 10½	9⅝	...
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	122 —132	120 —133	125	120½
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	83 — 86	83 — 86	85½	83½
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	105 —109	107 —111	109½	108
360,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	12½— 13½	12½— 13½	12⅞	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	107 —112	108 —113	110	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	98 —101	98 —101	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103 %	....	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	8 — 9	8 — 9	8⅛	8⅛
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	12 11/16	12⅝
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	27 — 29	26 — 28	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	36 — 40	37 — 41	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	100 —104	100 —104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ⅜	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	½— 1	½— 1	...	...
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	95½	...
200,000	Do Pref. shares	2	...	3⅛	3⅜	3⅛— 3⅜	3⅛— 3⅜	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	56 — 60	56 — 60	...	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5⅛	4⅜— 5⅛	5	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 96	94 — 97	95½	94⅓
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	101 —105	103 —107	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1⅛— 1 1/16	1⅛— 1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	6½— 7½	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	119 —125	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
40,008	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	103 —106	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	99 —101	99 —102	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅜— ⅝	⅜— ⅝	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½ - 12½	11½— 12½	12⅛	11 11/16
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	99 —102	99 —102	...	...
88,321	West India and Panama Telegraph	10	5%	...	...	¼— ⅜	¼— ⅜	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 5½	5½ — 6	5⅞	5½
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3½— 4½	3½ — 4½	...	...
80,000£	Do do do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 —103	100 —103	103	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —104	100 —104	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 — 9½	9 — 9½	...	...
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9 — 9½	9 — 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	9 7/16	9 5/16
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	105 —107	105 —107	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5¼— 5⅜	5¼— 5⅜	5¼	...
150,000£	Do. do. do. % Deb. Stock Red. ...	[illegible]	...	...	...	110 —113	110 —113	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	[illegible]	4 %	0 %	5 %	8 — 9	8 — 9	8½	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	123 —128	123 —128	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	103 —106	104½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	12 1/16	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	107 —110	107 —110	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	6½— 6⅝	6½— 6⅝	6 7/16	6 5/16
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5⅝— 6¼xd	6 — 6¼	6 7/16	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	107 —110	107 —110	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4¼— 4⅜	4 — 4⅛	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	...	...
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6¼%	15½— 16½	15½— 16½	16⅛	15⅞
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	99¼—100	97 —100	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	14 — 15	14½	14 7/16
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14¼— 15½	14¼— 15½	15	14⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8¼— 9½	8¼— 9½	9½	9
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1⅞— 2¼	1⅞— 2¼	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	180 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2⅝— 3¼	2⅝— 3¼	3 5/16	3
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	10½%	11 — 12	11 — 12	...	...

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation April 30th.	Closing Quotation May 7th.	Business done week ended May 7th, 1902. Highest.	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	4½— 5½	4½— 5½	4⅞	...
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	86 — 90 xd	86 — 90 xd	...	...
62,074	British Electric Traction	10	8 %	9 %	...	13½— 14½	13½— 14½	14⅛	13⅞
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12¼—12⅝	12½—12⅝	12⅝	12 9/16
600,000£	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	126	125⅝
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	8 — 9 xd	8 — 9 xd	8 9/16	8½
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	5⅝	5⅝
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½ %	5 %	Nil	½— 1	½— 1	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1½— 2	1¼— 1⅝	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	97 —100	97 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	17 — 18	17 — 18	17⅜	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5 15/16	...
90,000£	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	111 —115	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	103 —106	103 —106	105½	104½
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	103 —106	103 —106	104⅝	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	100 —103	100 —103	...	...
855,000	City and South London Railway	Stock	1⅞ %	1⅞ %	2 %	69 — 71	70 — 72	71½	70
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½ %	8 %	...	3 — 3½	3 — 3½	...	...
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	103 —108	103 —108 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½ %	...	⅛— ⅜	⅛— ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½ %	...	2 — 3	2 — 3	...	...
344,023£	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	75 — 80	...	...
100,000£	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	82 — 87	82 — 87	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1½— 1⅝	1½— 1⅝	1⅝	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½— 3	2½— 3	...	...
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	100½	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜— 10½	9⅜— 10½	10	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 — 101	98 —101	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	17 — 18	17 — 18	...	...
35,000	Do. do. do. 4½ % Pref.	5	4½ %	4½ %	...	5½— 6	5½— 6	...	...
50,000£	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21 7/16	21⅜
300,000£	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3⅜ %	3⅛ %	1⅛ %	4⅞— 5	4⅞— 5	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	10½— 11	10½— 11	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½—16½	15½— 16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	20 %	34 — 37	34 — 37	37	35
150,000£	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %	...	...	103 —106	103 —106	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10½— 11½	10½— 11½	11⅛	10⅜
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/16—3/16.
National Electric Free Wiring, 3/8—1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, May 7th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	42/-	39/-	3s. inc.
a Ammonia, Muriate (crystal) .. per ton	£33 10	£33 10	..
a „ „ .. per ton	£30	£30	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£18	£18	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90%).. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. per ton	£19	£20	£1 dec.
a Lead, Nitrate .. .. .. per ton	£24	£24	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C). per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	5d.	5d.	..
a „ Caustic (75/80%) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	120/-	125/-	5s. dec.
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 5	£6 5	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a „ Crystals .. .. per ton	£8	£8	..
a Bichromate, casks .. per lb.	2¼d.	2¼d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots per ton	£148	£148	..
b „ Wire, in ton lots per ton	£224	£224	..
b „ Sheet, in ton lots per ton	£191	£191	..
p Babbitt's metal ingots.. .. per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 3" to 12") basis per lb.	6¾d.	6¾d.	..
c Tube (brazed) .. .. per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn) .. per lb.	7d.	7d.	..
c „ Wire, basis .. .. per lb.	7d.	7d.	..
c Copper Tubes (brazed) .. per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) .. per lb.	9d.	9d.	..
g Copper Bars (best selected) .. per ton	£69	£69	..

METALS, &c. *(continued.)*	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£69	£69	..
g „ Rod .. .. .. per ton	£69	£69	..
c „ Electrolytic) Bars .. per ton	£63	£63	..
c „ „ Sheets .. per ton	£75	£75	..
c „ „ Rod .. per ton	£68	£68	..
c „ „ H.C. Wire per lb.	8d.	8d.	..
f Ebonite Rod .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
n German Silver Wire .. .. per lb.	1/5	1/5	..
h Gutta-percha fine .. .. .. per lb.	8/-	8/-	..
h India-rubber, Para fine .. .. per lb.	3/1 to 3/1½	3/1½ to 3/2	½d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) .. per ton	48/5	48/6	1d. dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. .. per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 .. per ton	£9 15	£9 15	..
g Lead, English Ingot .. .. per ton	£11 17 6 to £12	£12	2/6 dec.
g „ „ Sheet .. .. per ton	£13 10	£13 10	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bot.	£8 15	£8 15	..
d Mica (in original cases), small .. per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large .. per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings per lb.	11½d. to 1/3	11½d. to 1/3	..
p „ rolled bars & rods per lb.	1/- to 1/3	1/- to 1/3	..
p „ „ strip & sheet per lb.	From 1/3	From 1/3	..
o Platinum .. .. per oz.	£4 1	£4 1	..
p Silicium Bronze Wire .. .. per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n per ton	From £15	to £40	..
i „ „ in bars	£58	£58	..
g Tin, block .. .. per ton	£191 to £132	£180	£1—£2 inc.
g „ foil .. .. per lb.	1/8	1/6	..
m „ wire, Nos. 1 to 16 .. .. per lb.	1/7	1/7	..
p White Anti-friction Metals —			
„ "White Ant" brand .. .. per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls per lb.	7d.	7d.	..
j „ 6 lea. Flax .. .. .. per lb.	5¾d.	5¾d.	..
j „ 3 ply 10 lbs. Russian .. per lb.	4 13/16d.	5 13/16d.	..
j „ 10 lbs. Russian, single .. per lb.	4¼d.	4¼d.	..
j „ 180 lbs. Jute rove .. .. per ton	£10 2 6	£10 2 6	..
k Zinc, Sh's. (Vielle Montagne bnd.) per ton	£22 10	£22 10	..

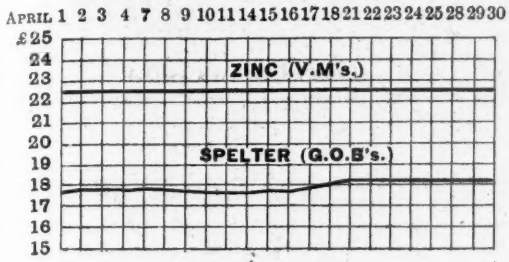
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

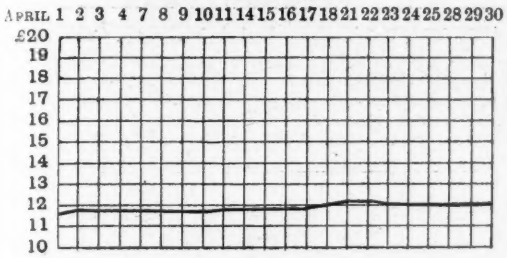
Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company, Ltd

METAL MARKET.

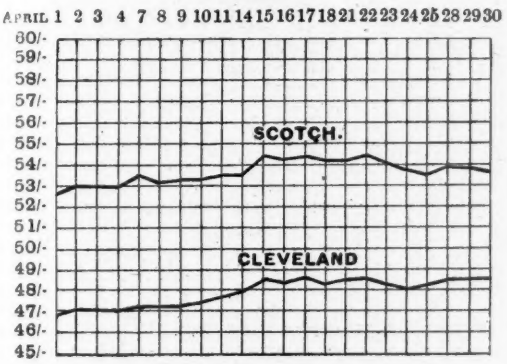
Fluctuations in April.



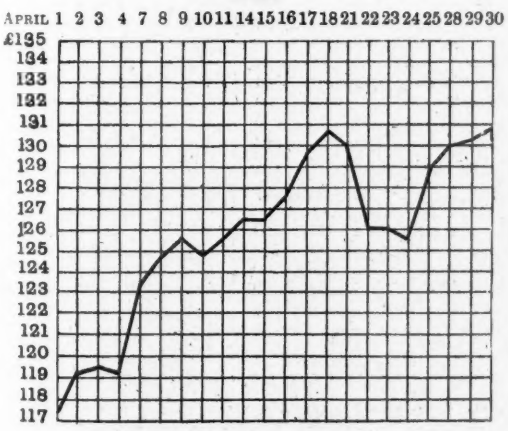
LEAD (ENGLISH).



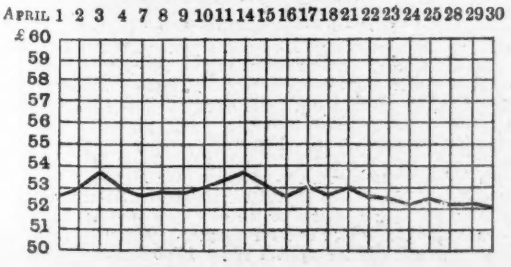
IRON.



TIN.



COPPER (G.M.B's.)



THE INDUSTRIAL FREEDOM LEAGUE.

This Association was formally inaugurated on April 22nd at the Westminster Palace Hotel. There was an influential platform; the railway interest being well represented, the chairman of the Great Central presiding, supported by Lord Claud Hamilton (chairman of the Great Eastern Railway), Mr. Harper (chairman of the Didcot, Newbury and Southampton Railway), besides many others associated with the greatest of all the private enterprises of the country. No wonder that the *Railway News* describes the movement as "A Railway Shareholders' Protection Association"—but it is as the largest ratepayers of the country that municipal trading affects the railway interest and not much from fear of their special business being interfered with by rate-aided competition.

It is true that municipal tramway undertakings may in some districts, and to a limited extent, compete with the railways, but as feeders to the stations they probably do much more to facilitate communication to and from the main lines, than to take away any of their customers.

The real character of the Association is not at all well indicated by the name chosen for it by its promoters, and we recommend an immediate change to one which better explains the object, viz., to free private enterprise from undue interference and rate-aided competition. The obvious name would be "The Anti-Municipal Trading Association," this would convey at once to the public that the object is to put a stop to the development of the socialism which aims at the ultimate absorption of all private trading, and that business enterprise which has created the commercial supremacy of the nation.

This is not a Railway Shareholders' Protection Association, but an effort to unite *every trade* in the country, with the object of putting a stop to the vicious encroachments of municipalities upon the business of the ratepayers, whose money they are using to deprive them of their own means of subsistence. Certain interests have been already attacked, some more directly than others, and these have naturally been the first to resent the interference, but if the growth of the system is to be stopped, every trader must combine, and they will make short shrift of the municipal competitor.

Every ratepayer is interested in the question, whether in or out of business, and the facts mentioned by speakers at the meeting of the Association should arouse their attention and awake them from their apathy and indifference to the local management of public affairs—which is, unfortunately, their normal condition throughout the country.

Lord Avebury, who has given so much attention to the subject of municipal trading, pointed to the working of the telegraph system by Government, which resulted in a loss of six millions, and which is increasing every year, and his allusion to the position of the railways in India, as an instance of the check to private enterprise, consequent upon their being in the hands of the Government, was a powerful argument in favour of free private enterprise as opposed to municipal monopolies. The extent to which municipal trading has already progressed was stated by the Chairman as already involving an indebtedness of £300,000,000, and there is no reliable estimate of the value of the assets which represent this enormous amount of debt for which the ratepayers are responsible.

Apart from the principle involved—which ought to dispose of the question—there is no justification in the results obtained, for the departure from the legitimate duties of a municipal council in order to make profits in reduction of rates, by competing with the ordinary business of the community; as Lord Avebury remarked, "if sufficient allowances were made for central office charges, for rent, for the head officials, law and depreciation, it will be found that the net profit is imaginary."

A striking instance is afforded by the financial results of the tramway service in the South of London, worked by the London County Council, and that in the North of London, which is a private enterprise; so far as the ratepayers are concerned, they gain an immense pecuniary advantage from the system in the hands of the company over that carried on by the Council.

In electric lighting it would be difficult to find one municipal undertaking that shows a profit—if the accounts are made up legitimately—and the public lighting supplied at cost price.

The efforts of electric lighting committees to justify their trading by presenting apparently favourable accounts is notorious, and auditors are constantly pointing out the unsoundness of the basis upon which they are prepared.

The action of the Municipal Electrical Association in rejecting the recommendation of the Municipal Treasurers and Accountants (Incorporated) that a provision for depreciation should be made, is one of the strongest proofs of the determination of municipal authorities to render their accounts without adhering to even the ordinary principles of accountancy.

Every man of business must know that payment of the original cost of an article by instalments cannot provide for the depreciated value 25 years afterwards; and yet the statement is made by the advocates of municipal trading that the sinking fund covers depreciation!

If it were practicable to keep the accounts in such a way as to limit every loan to the actual purpose for which the money was borrowed, the fallacy of the contention would be apparent; but the fact is, that renewals of worn out and antiquated plant purchased by one loan are made out of the proceeds of another, the fund for the original cost being necessarily exhausted by its payment, and as no reserve or depreciation fund has been provided out of revenue, fresh borrowings are of necessity devoted to the purchase of plant to renew that which has worn out or become obsolete.

There are some notable exceptions to the defective systems of accounts adopted by the great majority of municipalities, and these afford strong evidence against them.

At Glasgow—where no one can dispute the commercial acumen of the community from which the municipality is chosen—the necessity for making due provision for depreciation is admitted. In a paper prepared by W. W. Lackie, M.I.E.E., the assistant chief engineer of the Glasgow Electricity Works, he specifies the amounts that should be provided to cover depreciation upon the following percentages on cost, viz:—

Land and buildings	1 per cent.
Machinery and plant	7½ „
Accumulators	10 „
Mains and cables	2½ „
Meters	6 „
Instruments	5 „
Furniture...	5 „

and he estimates that this calculation amounts to 4 per cent. on capital expenditure.

The Aberdeen Corporation allow, on the average, 3 per cent., and this may be taken as the lowest provision that prudence would dictate.

The new association has an arduous but most beneficial work before it. A branch should be established in every town, not on the plan of existing ratepayers' associations, which are too often mere standing election committees in the interests of certain candidates, but formed of the traders and entirely free from party politics.

The co-operative societies should be invited to support the movement, for municipal trading is entirely opposed to their principles, which are based upon practical acquaintance with the business and provision of the capital by themselves.

We congratulate the Association upon a good send-off, and with a more appropriate name and a thorough organisation throughout the country, success will assuredly be achieved.

ELECTRIC TRACTION.

[Paper read at the Town Hall, Northampton, before the Tramways Committee and others.]

By PHILIP DAWSON.

The real advent of electric traction in England may be said to date back to the opening of the Bristol line in 1895. The Bristol electric tramways, although not by any means the first opened, was the first electric line which was commercially successful from the beginning. Since that date enormous progress has been made, so that at the present day there are 85 electric tramways and railways in actual operation, while there are over 100 tramways and light railways under construction or conversion, which are intended to be worked electrically. The following figures give a very good idea of the state of things at the present day:—

Electric Tramways and Railways in the United Kingdom.

	Route mileage.	Track mileage.	Number of cars.
Constructed ... ... approx.	800	1,300	4,000
Under construction	600	900	800
Authorised and about to be c'nstr'cted	1,000	1,400	—
Total	2,400	3,600	4,800

A series of tables which may be of interest have been compiled, and give an idea of the cost of installation and operation, as well as of the probable results which may be expected.

Some figures are also given showing the enormous increase of traffic which takes place when electric traction is introduced and the rapid growth of electric traction.

This system is no longer in its infancy, and it has not only been applied with remarkable success in the United States and on the Continent of Europe, but it has within the last six years found great favour in our country, and the importance which it has attained may be gauged by the capital which has already been invested in it.

In 1896 the total capital invested in electric undertakings in this country was about £6,000,000. No Corporation had at that time invested any money in that branch. At the end of last year the total capital invested by private companies exceeded £40,000,000, and municipalities had invested over £11,000,000, making a total investment of over £51,000,000. The schemes of power distribution may, for our purposes, be also counted in, as a large number of them will undoubtedly supply electric current for traction purposes. The capital which has already been raised for such undertakings amounts to nearly £20,000,000. If we take into consideration the new tube railways, and the conversion of the Metropolitan and District Railway to electric traction, which that successful American financier, Mr. Yerkes, has now in hand, we shall have to add another £20,000,000; it will thus be seen that, taking all the power distribution and traction schemes which are now either completed or under construction, the total amount of money invested reaches nearly £100,000,000. Taking the capital expended on electric light undertakings, we find that the municipalities have spent, in round figures, £16,000,000, and private companies £28,000,000. It will be seen from these figures that the subject under consideration is therefore a very important one. The enormous increase of electric traction in the United States is remarkable; thus, in 1894, of the total tramway systems in America, amounting to nearly 13,000 miles, 9,000 miles were operated electrically. At the present moment over 20,000 miles are operated electrically, and approximately, 60,000 cars are in circulation.

Table I.—New York City Surface Lines (from *Street Railway Journal*).—Population, 3,370,000.

	1901.	1900.	1899.	1898.
Miles of track ...	963	952	930	914
Passengers carried...	871,799,558	816,661,361	753,740,052	679,967,283
Car-miles operated	110,557,911	112,361,704	112,671,413	105,797,835
Car-miles per mile of track	114,800	118,000	121,100	115,800
Passengers carried per mile of track	905,000	858,000	810,000	744,000
No. of times population carried ...	260	240	220	200

Table II.—Growth of Passenger Traffic on New York Surface Lines.

	Approximate.	
1890 ...	224,000,000	
1891 ...	238,000,000	
1892 ...	268,000,000	Period of changing motive power and consolidation of lines.
1893 ...	265,000,000	
1894 ...	263,000,000	
1895 ...	263,000,000	
1896 ...	320,000,000	
1897 ...	380,000,000	
1898 ...	400,000,000	
1899 ...	465,000,000	
1900 ...	559,000,000	

Table III.—Approximate Capitalisation of Electric Tramways.

Name.	Population.	Miles of route.	Capitalisation. Total.	Capitalisation. Per mile of route.
Birkenhead ...	110,926	11	112,000	10,000
Blackburn	137,000	4	225,000	56,000
Blackpool & Fleetw'd	—	9	190,000	21,000
Bradford	279,767	25	338,000	14,000
Bristol	321,908	28½	960,000	34,000
Coventry	73,000	10½	130,000	12,000
Dover	44,000	3½	38,000	11,000
Dublin United ...	252,239	45	1,715,000	38,000
Glasgow	762,000	20	1,681,000	84 000
Halifax	106,000	13½	117,000	9,000
Huddersfield ...	95,000	20	266,000	13,000
Hull...	240,620	9½	270,000	28,000
Leeds	428,953	25	217,000	9,000
Liverpool	684,947	66	1,084,000	16,000
London United ...	—	13	494,000	38,000
Manchester ...	543,969	75	900,000	12,000
Norwich	111,728	14·4	330,000	23,000
Portsmouth	183,160	15	602,000	40,000
Sheffield	400,000	18	233,000	13,000
Central London ...	—	6·5	3,550,000	546,000
City & South London	—	6·0	2,081,000.	347,000
Liverpool Overhead	—	2·5	790,000	318,000

The total station capacity in kilowatts installed for lighting and traction purposes in the United Kingdom amounts to above 500,000 kw., and that at present being installed in the neighbourhood of 150,000 more. The total station capacity installed in London for all purposes is not much over 100,000 kw. This sounds a great deal, but if we compare these figures to those of New York City, we find that New York has nearly 250,000 kw.

Some figures showing what surface lines or tramways have done in other towns may be of interest. Taking New York City with a population of 3,370,000, we find that the tramways carry the total population 260 times every year; further details, showing the rapid increase in traffic due to the electrification of the New York line, are given in Tables I. and II., from which it will be seen that within the last five years the traffic has more than doubled. Taking into consideration the elevated roads and the various outlying districts which make up greater New York, we have a population of, in round figures, 3,500,000, and the tramway and elevated railway system carry 1,200 million passengers per

annum, or, in other words, the total population of New York is carried once a day. Comparing these figures to what is obtained in London, we find that the tramways omnibuses, and Metropolitan lines only carry from 60 per cent. to 70 per cent. of the population of greater London every day, from which it is evident that the inhabitants of London do not move about as much as those of New York. This may possibly be attributed to the difference of temperament, and the different mode of conducting business. The total length of the London tramway system is, in round figures, 140 miles. A very important point, and one which has to be considered when comparing financial results obtained in England and America, is the average fare per passenger carried. From careful investigations which have been made, and from the figures given by Mr. James Dredge in an article of his which appeared in the March number of *Traction and Transmission*, it appears that the average amount paid per passenger on the different London transit systems is approximately 1½d., whereas in New York there is a uniform fare of 5 cents, or 2½d. It is evident from this that lines which would pay very well in America might not pay in England. Besides this fact, there is another one which has to be considered, viz., that the difference between the income and the actual expenses incurred by the working population of this country is a much smaller quantity than that which is at the disposal of the American workman, and it is, therefore, probable that whilst the American will travel on an electric car for a very short distance, and whenever he gets a chance, the English workman will only travel when he is forced to do so.

It may be interesting to examine the probable costs of electric installation. It will be evident, from a glance at Table III., that there is a very large variation of the capitalisation per mile of route. It is also evident that the smaller the system the less will be the cost per mile of route, provided the general conditions are favourable. It will be seen that the total expenditure varies from a minimum of £9,000 per mile of route in the case of Leeds and Halifax to respectively £56,000 and £84,000 in the case of Blackburn and Glasgow. As regards main lines, railways, such as the Liverpool Overhead and the London Tube; the capital expenditure must be very much heavier, and has reached, in the case of the Central London Railway, over half a million per mile of route. It may be stated that, for estimating purposes, the very best system, including power station, track, car, overhead work, feeders, &c., should be installed for from £15,000 to £20,000 per mile of route.

The way in which this total cost is made up is shown in Table IV., from which you will see that the total cost of the power station can be safely taken at £30 per KW. installed, and that as regards the motor cars, a figure of £750 is a safe one to estimate on. For the permanent way with standard gauge and for heavy rails, such as are now nearly always adopted, £6,000 per mile of single track should be allowed. As regards the overhead construction, a figure of from £1,500 to £2,000 per mile of route is a safe one to estimate on. It must, however, be pointed out that all these figures can be used for roughly approximating costs and preliminary estimates only, as the conditions that obtain may considerably influence the total cost. It is only by a traction expert examining these conditions in the light of his experience that a real idea of the total capital which will eventually have to be expended, can be obtained.

In investigating the question of how much money can be properly invested, it is necessary to ascertain the probable receipts and expenditure, and for this purpose I have prepared Table V. It will be seen that the population, in the cases given, is carried from 65 to 180 times a year. The receipts per head of population vary, in the figures I give, between 5s. and 19s. per head. It will be seen that the receipts per mile of route vary between £2,200 and £7,300.

TABLE IV.—APPROXIMATE COST OF VARIOUS PARTS OF ELECTRIC TRACTION SYSTEM.

Approximate Cost of Modern Power Plant per KW. Installed.

	£ s. d.	£ s. d.
Buildings	4 0 0 to	16 0 0
Boilers	2 0 0 to	5 0 0
Steam and water piping and feed pumps	0 12 0 to	3 0 0
Steam engines and condensers ...	3 0 0 to	11 0 0
Dynamos and switchboards ...	2 10 0 to	12 0 0

Total cost of power plant, not including buildings, £25 to £35.

Approximate Cost of Rolling Stock.

Maximum traction trucks per set	£130
Ordinary bogie trucks per set	125
Standard four-wheel truck	70
Extra long truck	75
Double-deck car bodies	£220 to 300
Single-deck car bodies	210 to 265
Double-motor equipment, including resistances and controllers ...	260 to 320
Single-car motor, 15—50 H.P. ...	75 to 120

Cost of Track Laying.

Cost per mile of single track, 4 ft. 8½ in. gauge, 100-lb. rails, wood or granite paving, including necessary electrical bonding ... ... £5,500 to 6,500

Overhead Work.

Cost per mile, three-section tubular poles, standard brackets, 1/0 trolley wire.

Double trolley wire on side brackets	£1,100—1,400
" " span wire	£1,700—2,000
" " centre brackets	£1,300—1,500
Single trolley wire, side brackets	£1,000—1,200
" " span wire	£1,600—1,800

TABLE V.

Name.	Population.	Miles of route.	Passengers carried.	Passengers carried per mile of route.	No. of times pop. was carried.	Total receipts.	Receipts per cap.	Receipts per mile of route.	Receipts per car-mile.	Average fare per pass'ng'r.	Ratio of expenses to receipts.	Total expenses.
						£	s.	£	d.	d.	%	£
Bristol	329,000	28	26,972,000	960,000	82	165,115	10	5,900	—	1·47	67	110,795
Cork	75,000	10	5,137,000	514,000	68	21,875	6	2,200	7·2	1·02	63	13,840
Dover	42,000	3	2,710,000	903,000	65	11,141	5	3,700	10·0	·98	85	7,997
Dublin United ...	252,000	45	45,165,000	1,000,000	180	241,825	19	5,400	—	1·28	67	161,692
Halifax	106,000	13·5	9,430,000	700,000	89	39,383	7	2,900	13·3	1·00	77	30,273
Hartlepool	23,000	5·0	2,130,000	426,000	93	12,266	11	2,400	—	1·38	62	7,557
Hull	241,000	9½	19,350,000	2,040,000	80	80,118	7	8,400	10·5	·99	49	39,754
Leeds	429,000	25	39,240,000	1,570,000	92	183,199	9	7,300	12 6	1·12	61	121,402
Liverpool	685,000	66	93,768,000	1,420,000	137	455,530	13	6,900	12 2	1·16	73	330,073
Middlesbro'-Stockton	—	9	8,783,000	976,000	—	47,219	—	5,200	—	1·29	69	32,581
Norwich	112,000	14·4	7,816,000	542,000	70	36,376	6	2,500	9·4	1·11	62	22,463
Blackpool	47,000	9·5	4,912,000	517,000	104	33,060	14	3,500	15·0	1·62	59	19,535

TABLE VI.—ROUBAIX—TOURCOING ELECTRIC TRAMWAYS.

Increase in Passengers Carried.

1897	4,484,025
1898	4,763,980
1899	5,365,500
1900	7,120,420

30 klmts. of route at end of December, 1900.

Ratio of Expenses to receipts.

1895	65 per cent.
1896	58 "
1897	56 "
1898	54·8 "
1899	53·5 "
1900	54·6 "

Population, 204,000.

The average fare per passenger varies from ·98d. to 1·62d., and the ratio of operating expenses to receipts from 49 per cent. to 85 per cent. Table VI. gives some figures for electric systems in the North of France, and shows the rapid increase in traffic, and the decrease in ratio of expenses to receipts. Table VII. gives the increase of passengers carried in the case of some British electric tramways; it will be seen, for instance, that in the case of the Dover electric tramways, the passengers have more than trebled within the last three years. In this connection the figures as regards the City of Berlin, with a population of 1,810,000, may be of interest.

TABLE VII.

—	Passengers carried per annum.			Miles of route open.		
	1898.	1899.	1900.	1898.	1899.	1900.
Blackpool Corp.	2,279,209	2,881,027	3,421,736	4	4	6
Blackpool and Fleetwood ...	Opened July	1,782,683	1,831,531	—	8	8
Cork	" Dec.	4,744,528	5,137,141	—	8·25	9
Dover	787,745	2,170,590	2,437,863	3½	4½	4½
Halifax ...	Opened June	2,594,478	7,308,998	—	6·33	11·125
Leeds	15,620,985	24,237,440	27,634,105	21·75	23	26
Liverpool ...	Opened Nov.	63,771,450	82,367,958	—	78	82

(To be continued.)

THE PONTYPRIDD POWER STATION.

Wednesday, April 30th, was a notable day in the history of the large industrial district of which Pontypridd is the centre, for just below it (Cardiff-wards) Sir Frederick Bramwell laid the foundation stone of the first generating station constructed by the South Wales Electrical Power Distribution Company. He was accompanied by Mr. H. Graham Harris, his partner (the firm are the engineers to the undertaking), and Mr. Hood, Llwynpia colleries, and other magnates of prominence were in evidence—notably the representatives of the County and other Councils (large and small)—many of which appear likely to figure as clients of the company. The place where the works are in progress impinges on an immense and unworked coal area, within easy distance of the great mining industries of Glamorganshire and Monmouthshire, and just 10 miles from Cardiff. Special arrangements had been made by Mr. Hill, the manager, for the visitors, and after the opening there was a luncheon.

The South Wales Company have, besides the station at Pontypridd, other power stations in hand at Neath (West Glamorgan), and Bridgend, and yet another at Pontypool—the heart of Monmouthshire.

The alternators to be put down at Pontypridd by the company will generate electric energy at a pressure of 12,000 volts. Five Willans engines and Ganz generators of 3,000 H.P. each will be put down at the outset with 24 large Niclausse water-tube boilers. When completed the Pontypridd equipment, however, will contain 25 engines and alternators of 3,000 H.P. and 120 boilers. The company will commence to run their high-pressure (12,000-volt) mains early in the coming summer, and the first area in which the mains will be laid will be the Rhondda Valley. A temporary plant will be running on the Pontypridd ground by the middle of June. Messrs. Holloway Brothers, of London, are the building contractors.

Four or five hundred ladies and gentlemen were present at the laying of the foundation stone. Mr. Archibald Hood, who is chairman of the company, introduced Sir Frederick Bramwell to the assembly, and referred to the splendid past of their guest-in-chief in glowing terms, which the assembly enthusiastically punctuated, also Mr. Hood's allusions to the vast possibilities of electricity.

Mr. Henry Holloway presented Sir Frederick with the trowel, which was suitably inscribed.

Sir Frederick Bramwell then declared the stone well and truly laid, and delivered a terse and felicitous little speech, reserving himself, as he said, for a fuller deliverance under shelter. The company subsequently adjourned to the luncheon marquee.

Mr. Hood again presided, and after the repast proposed "The King," and a stanza of the National Anthem was sung.

The Chairman then proposed the toast of the day, "Prosperity to the trade of South Wales, and success to the new undertaking." He coupled with the toast the name of Sir Frederick Bramwell.

Sir Frederick Bramwell, in responding, said that there was some sort of propriety in his being present on an occasion which related to the distribution of power from a central source. He had been apprenticed to John Haig, who was one of the first men who advised and carried out this process and provision. That power was by means of exhaustion of the air; the pressure was 10 lbs. on the sq. in., and it was very effective. Samuda, whose name was so much associated with the early development of the atmospheric railway, was an apprentice to the same preceptor. Here, in this matter of central distribution, might perhaps be found the cause for his being there at that celebration. Well, there had been a tendency for many years to do things, as it were, in a wholesale manner rather than in the retail—to get to the end at once rather than pass through the gradual stages. He described the wax candle days and the intricacies of candle lighting with much irony. The "match" and a variety of other things followed, said Sir Frederick, and then came gas. But this was not light, only a potentiality, and people wanted light. Then came the electric light. When they gave a man a ton of coal they gave him the means to produce power—not the power. That company proposed to supersede obsolete methods—to give their clients the means to utilise the power of electricity itself in the way most convenient for general manufacture, in rotary form, not in reciprocating, though always easily converted into reciprocating when wanted. He referred with emphasis to a letter he had received from a dear and intimate friend of his in the United States, which had reference to the electric power supplied at Niagara Falls. The distributing power there, according to this gentleman, was in the first house 50,000 H.P., and was fully engaged. They had so many engagements coming on, that they were now providing 25,000 H.P. in a second house, and they were ordering 30,000 H.P. more, making 105,000. The promoters there were now crossing to the Canadian side of the Fall to establish a power house containing three 10,000-H.P. generators. The work had been actually accomplished, though at the outset there was little to hearten the promoters, for the next nearest customer was Buffalo, 18 miles away. But the difficulties had been faced and overcome, and there had resulted an enormous demand for the power. In South Wales, too, at these works it was proposed to give the electric power in its best form. That meant the supply of electric energy for motive power in the factories and on the tramway, the railway, and for electro-chemical work. The last mentioned was now coming to the front, so was electro-thermal energy coming into use. These provisions were not cumbered with the old auxiliaries, which, with their smoke, defiled the charming valley around. There was completeness in the provision—the cables might be looked upon as a web. It was hard work to get an Act, and still more so to get customers to believe in the project. They desired profits. But in getting profits what was it they did? He viewed it as a most important work for the welfare of the kingdom—the saving of fuel. He could give them his own experience of the amount of fuel used in petty non-condensing engines. Fuel he regarded as sacred, as in fact the life-blood of the nation. He could not contemplate the existence of our nation without it, except as a desert island. He fervently trusted that God would bless "the undertaking of the South Wales Company."

Lieut.-General Sir Richard H. Sankey, K.C.B., R.E., proposed "The Engineers," and Mr. H. Graham Harris having responded, the ceremony came to a close.

CURRENT SPECIFICATIONS.

CI.—DARTFORD EXTENSIONS.

Summary.

Extent of Contract.—Section A.—Supply, delivery and erection of one 300-KW. steam dynamo, the necessary pipework and switchboard extension. Section B.—Supply, delivery and erection of one Lancashire boiler, feed pump, feed pipes, and extension to present fuel economiser.

Type and Size of Boiler.—To be of Lancashire type, capable of easily evaporating 4,000 to 4,500 lbs. of water per hour, with average coal and cold feed.

Working Pressure.—160 lbs. per sq. in.

Mechanical Stoker.—One to be fitted of Messrs. Cass & Co.'s manufacture, complete with hopper, furnace fittings, and driving gear.

Feed Pump.—One to be supplied of vertical compound type, capable of easily supplying at moderate speed 2,000 gallons of water per hour against a boiler pressure of 160 lbs per sq. in.

Fuel Economiser.—Sixteen additional 6-ft. patent tubes, to be fitted to the existing fuel economiser of Messrs. Carter & Son's make.

Engine.—To be of the enclosed self-lubricating type, and to run at a speed not exceeding 350 revolutions per minute.

Conditions of Working.—Engine to be either compound or triple-expansion, to work with 150 lbs. steam, at present non-condensing, but provision to be made for satisfactory working at a later period if necessary, condensing.

Range of Governing.—Variation between full and no load not to exceed 2 per cent. Momentary variation, when full load is suddenly removed, not to exceed 7 per cent. Governor to be adjustable by hand whilst running.

Dynamo.—To be compound wound, with provision for cutting out series coils, to give as full load 300 KW. at 500 to 550 volts. When used as a shunt machine to develop full load at 460 to 500 volts.

Temperature Rise.—Not to exceed 70° F. above surrounding atmosphere after 12 hours' full load run.

Specified Overload of Set.—10 per cent. above normal full load for periods of one hour working non-condensing.

Guarantees.—Guarantees as to steam consumption, efficiency, &c., to be given in tender.

Extensions to Switchboard.—Supply and fixing of specified instruments to spare panels of existing switchboard.

Cable Connections.—The necessary connections between dynamo and switchboard to be provided as specified.

Specified Date of Completion.—To be stated in tender.

Penalty for Late Completion.—One per cent. per week of contract price for either section for first four weeks, then 2 per cent. for further weeks.

Period of Maintenance.—Twelve months from date of completion.

Terms of Payment.—80 per cent. of value of work delivered as work proceeds, up to 90 per cent. on completion, 10 per cent. at end of period of maintenance.

Amount of Surety demanded.—20 per cent. of contract sum.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—Rates accepted as current in the Council's district to be paid.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—May 10th, 1902.

This specification has been prepared by Mr. A. J. C. Waterland, the resident engineer to the Council of Dartford. The wording is very open and permits the tenderer to make offers of his own type of plant. It will be noticed that either compound or triple-expansion engines may be proposed, and that provision is to be made for working condensing later.

Sufficient fly-wheel power is also to be provided to permit of the set being used for traction work if required.

In the general conditions the arbitration clause is satisfactory as drafted in Clause 34, this being taken to override the wording of Clause 5, where it is stated that as regards meaning of specifications, accuracy of plan, &c., the decision of the engineer shall be final.

The penalty for late completion is stated to be 1 per cent. per week for the first four weeks late, and 2 per cent. for any further delay.

In view of the "model" conditions recently proposed by the Council of the Institution of Electrical Engineers, we suggest that

exception be taken by tenderers to any increase on the amount of 1 per cent. per week.

Similarly, a reduction in the amount of surety required from 20 per cent. to 10 per cent. of the contract price should be asked for.

It is probable that the intention of the clause referring to wages to be paid to workmen simply means that all work done on site shall be paid for at current local rates, and that similarly work done at manufacturer's works shall be paid for at rates in accordance with those local conditions. This is acceptable, but as phrased it may be read to mean that no rates lower than those prevalent in Dartford should be paid for any of the work connected with the contract, a stipulation which might prove very inconvenient and irritating.

OPENING OF THE CARDIFF ELECTRIC TRAMWAYS.

By a happy coincidence, the very week in which the South Wales Electric Power Distribution Company laid the corner stone of their great enterprise near Pontypridd—nay, the very next day, "May Day," witnessed the virtual completion of the greater part of the electric tramways in the Welsh commercial capital of Cardiff, and the running of the first dozen electric cars there for ordinary traffic purposes. Nearly a dozen miles of track were traversed in about two hours and a half (with halting for ceremonial functions) by the Mayor of Cardiff (Councillor F. J. Bevan), Corporation members, and 300 to 400 invited guests.

The work has been carried out under the capable supervision of Mr. W. Harpur, the Cardiff borough engineer, and Mr. Ellis, the electrical engineer for the Municipality, and their joint labours have been generously appreciated and fostered by the Cardiff Corporation Committee, over which Mr. T. Andrews has presided. By the time the whole scheme has received its finishing touches, it will have meant an outlay of at least half a million of money. Up to the Thursday, £380,000 had been spent in covering the arteries of Cardiff trade, and the adjoining residential points—Carton, Roath, the Docks and Grangetown.

In another three or four years it is fully anticipated that Cardiff will have above 20 miles of electric tramlines—outreaching to the more distant appendages of Penarth, Whitchurch and Cardiff—and helping to give prestige to that greater Cardiff which is so rapidly being built up. The electric power station is situated at the end of the Roath section (Cardiff West End). There are four 500-H.P. Musgrave engines with Westinghouse generators, and others of 1,600 H.P. are on order. Over 100 cars are provided by the scheme, each costing between £540 and £650. There is no reduction on the old (private company) fares; experience has shown than non-residents have in former times been the chief car patrons, and with so much civic work on hand and in perspective it is not thought that Cardiff could afford, under the circumstances, to dispense with so large a source of revenue as the difference between the "regulation" fare and a reduced figure.

The electrical engineer was precluded from joining in the whole of the opening ceremonies owing to prostration, brought on, it is to be feared, by excessive application to his duties. Deep and general sympathy was expressed with Mr. Ellis, who, happily, has an excellent and devoted deputy in Mr. C. E. Davies.

At the start of the inaugural run along the new tracks the Mayor was presented by the deputy electrical engineer with a controlling handle of silverplate and ebony (suitably inscribed) to drive car No. 1. At the power station his Worship also started the engines and turned on the current at the switchboard.

In the afternoon the Mayor presided over a civic luncheon at the Cardiff Town Hall.

"The King" was afterwards proposed from the chair, and "The Mayor and Corporation of Cardiff" was submitted by Mr. Ll. Wood.

In responding, the Mayor expressed the most absolute confidence in the prospective success of their electric tramways at Cardiff, and as an eloquent proof of the reasonableness of his assumption, he cited the striking fact that, whereas in the year 1890 the old tramway owners carried at Cardiff 9,537,583 passengers, in 1901 they carried an additional 5,478,164. If so much could be done under the former *régime*, the Corporation could surely keep up the ratio of increase.

Alderman Dd. Tynes proposed "The Tramways Committee." He remarked that the track had been well laid under the supervision of the Public Works Committee over which Alderman Sorradale so well presided, and that gentleman and Mr. Harpur deserved their truest congratulations.

Mr. Andrews, chairman of the Tramways Committee, in responding, said that he believed that ere long the Council would be making over £10,000 a year profit from their electric tramcar revenue. He trusted that the contractors for the supply of cars would soon have the non-arrivals delivered, and so save the Corporation loss of revenue.

The "Health of the borough engineer (Mr. Harpur) and the borough electrical engineer (Mr. Ellis)" was then submitted by Mr. Andrews, who pointed out that Mr. Harpur had kept his promise, despite the incredulity of the unbelieving, and laid the tramway track down in six months, and he held that the Corporation would do well to give Mr. Harpur, who had rendered Cardiff faithful and efficient and energetic service for 25 years, a substantial token of their appreciation, and that Mr. Ellis, who though only 30 years old, had done the work of three men, and whose ability was so marked, should be urged to rest and recruit. He also spoke highly of Mr. Davies, Mr. Ellis's capable deputy.

Mr. Harpur, in responding, took a brief retrospect of the history of the local electric tramway scheme, whose general inception he dated back to November, 1896, though the Corporation did not make up its mind actually to commence the work till 18 months ago. Since then the amount of work which had been accomplished would bear comparison with that done in any other town in the country, or with the American work, while as to the quality, their "American cousins were left far behind." The tramway laying commenced on December 18th, 1900, and the first rail was laid by the ex-Mayor (Mr. Andrews) on the first day of the new century. The lines of the Cardiff Tramway Company were purchased on January 31st, 1901, and the work of reconstruction commenced immediately the last car of the company had run. He had reedemed his pledge as to the reconstruction of the lines, and had been greatly helped by the forbearance of frontagers, &c., along the lines of route, who saw that the less harrass the more expedition, and the quicker easement for the rates. He warmly eulogised this display of public good sense and spirit, and after touching briefly on the vast multiplicity of detail work involved in the scheme (but not visible to the general vision), he concluded with a kindly tribute to Mr. Ellis and Chief Inspector Lock.

Mr. C. E. Davies replied on behalf of Mr. Ellis, the borough electrical engineer.

Mr. J. W. Courtis proposed "The Contractors," and associated with the toast the names of Mr. Musgrave, of Musgrave & Co., Bolton, who erected the engines; Mr. Armstrong, of Messrs. Dick, Kerr & Co., who supplied the cars; and Mr. W. Symonds, who built the power station. Musgrave's firm was known all over the world (said Mr. Courtis), and their massive engines went like clocks, and Messrs. Dick, Kerr's cars were admirably finished utilities; he expressed high satisfaction, too, with the work done all round by the rest of the contractors. The British Westinghouse Company had supplied generators which had given every satisfaction; and Messrs. Ferranti's switchboards were splendid looking. As for the car station built by one of their eminent local contractors, Messrs. Williams & Co., it would prove a Cardiff landmark. Incidentally, Mr. Courtis commended to the consideration of those interested the remark made by the chairman of the London United Tramways, that during the three months the electric tramways had been running, a larger revenue had been earned than was got from the horse cars for 12 months.

Mr. Musgrave, in responding, said that they need not in this country fear competition with American "soaring" eagleism—England was learning the strength of its own capabilities. "The first dividend in six years" was the substance of a notification which his firm had had after starting an installation for a London corporation.

Mr. Armstrong said that he considered that Cardiff had one of the best electric tramcar services in the kingdom.

Mr. Symonds also replied, and the Mayor's health having been toasted, and that of the President of the Cardiff Chamber of Commerce (Mr. Davey), both gentlemen acknowledged the compliment.

ELECTRIC CONSTRUCTION COMPANY, LIMITED, WOLVERHAMPTON.

In connection with the Art and Industrial Exhibition now being held in Wolverhampton, a general invitation is extended to visitors interested in electrical matters to visit the works of the above company at Bushbury, and on Friday in last week a gathering of a more special nature took place upon the premises, the company comprising a number of gentlemen representing the technical and newspaper press. The visitors were cordially received by one of the directors of the company, Mr. J. Irving Courtenay; Mr. James Gray, managing director; Messrs. G. S. Moore and W. Bullock, joint managers; and Messrs. Buchanan and Boyden, chief engineers. A luncheon was served in the offices, after which Mr. Courtenay extended to the visitors a hearty welcome, and expressed his regret at the absence of Sir Daniel Cooper, the chairman of the company. Mr. Courtenay then went on to say that the Electric Construction Company had what he thought might fairly be termed a very creditable exhibit at the Exhibition, but as sometimes they were asked whether the company was in a position to turn out the large work now demanded, it was thought that ocular demonstration would be the most convincing proof of the company's ability to build the very largest electrical plant required anywhere. New shops had been recently finished and equipped after long delay, owing to the difficulty in getting delivery of the superb and up-to-date machine tools which were now to be seen in them. The Electric Construction Company does not, Mr. Courtenay said, manufacture electrical accessories, such as meters, small switchwork, &c., but lays itself out for all kinds and sizes of electrical machinery. The company is not engaged only on continuous current machines or traction machinery, but is manufacturing the latest and most efficient machines for dealing with the newest problems, both continuous and polyphase current, whether motors or generators, and thus the breadth of the company's experience is perhaps greater than that of any other British firm, especially in the design and manufacture of

such machines as continuous and polyphase motors, generators, rotary converters and transformers for heavy current or high voltage, boosters either for battery or line working, pressure raisers or pressure reducers of the rotary or stationary type. In short, there is no size of machine yet in use, or likely to be in use, that the new plant is not equal to tackling, and the company have a staff that has experience in handling large contracts in their entirety and controlling them right throughout. In these days, added Mr. Courtenay, when foreign competition is upon us in full swing, it behoves those whose duty it is to face and overcome this competition to be on the alert, and the directors of the Electric Construction Company have spared neither money nor endeavour to render their workshops, by these important additions, capable of executing well and speedily whatever may be required of them, and he felt sure that they would be able to hold their own against all comers.

The visitors were afterwards conducted through the works, the various departments being explained by the chiefs thereof. The works were erected in 1892, when, it is said, they were the only ones in the country for which it could be claimed that they were designed and built throughout for the purpose of electrical machinery construction. The area of the site on which they stand extends to about 25 acres, of which one-fourth is covered by buildings. Electrical generating plant and accessories are constructed throughout from the raw material, even the necessary castings being made by the company on the spot. During the last 12 months a large machine shop, specially designed and aid out for handling large electrical generating units, has been added. This shop contains some of the largest and most up-to-date machine tools ever made—notably a boring mill, capable of dealing with a piece of machinery 32 ft. in diameter, and another 20 ft. in diameter; a planing tool, capable of dealing with a bed-plate or similar piece 18 ft. by 12 ft.; and a radial drill for boring rings up to 20 ft. diameter from the floor level. The large pieces of machinery dealt with in this shop are handled by means of two electrical cranes, 80 ft. span, having a combined capacity of about 60 tons. A considerable portion of the floor space in this shop is occupied by a massive face plate, on which are found a number of portable tools, automatic and otherwise, which greatly facilitate the performance of certain classes of work and materially minimise the cost of production. Every description of electrical machinery for railway, lighting and motive power, is manufactured at the works, which are, of course, driven electrically throughout, and a special feature is that one part is driven by continuous current, and another part by three-phase current. This is done to illustrate the special features of both systems. One kind of current is also turned into the other kind by means of a rotary converter, and both work in unison by this means. The factory employs 1,000 hands, and during the visit on Friday some very fine samples of work were inspected, including machines for the War Office and for a large number of home corporations for tramway undertakings, and for numerous concerns abroad.

INSTITUTION OF ELECTRICAL ENGINEERS.

SOME NOTES ON POLYPHASE MACHINERY.

By A. C. Eborall.

(*Paper read at Manchester, March 25th*, 1902.)

(*Continued from page* 700.)

A deduction that follows naturally from what has just been said is that, for a given frequency a high engine speed is very favourable to good parallel running, for the number of pole-pairs decreases, thus permitting a greater cyclic irregularity (lighter magnet wheels) for the same value of phase displacement; on the other hand, the turning moment of English high-speed engines of the three-crank class is usually so good that it often happens that the fly-wheel effect of the dynamo-maker's standard magnet wheel is sufficient to give a smaller cyclic irregularity than would be permissible, without the provision of any additional fly-wheel effect at all. High speed is exceptionally favourable for the operation of polyphase generators of all types, and (without exception) for all classes of work; quite apart from considerations of parallel running, such generators become electrically better. Both the efficiency and regulation are better at high speeds, and, generally speaking, a better machine all round results, which can be sold at a lower price than the corresponding slow-speed machine. When these facts become better known in this country, it will be of interest to see whether the high-speed engine builders will study the question of large engine units, which are a feature of modern polyphase working, and develop very large high-speed engines, which will compete with the present slow-speed types on the question of steam economy—about the only point at which they are at a disadvantage. The author ventures to think that the use of highly superheated steam could do much in this direction, for the construction of high-speed engines should be favourable to this; as to the limit of speed, as far as the generator is concerned, a speed of 150—200 revolutions per minute for a 4,000-kw. machine (or more than double that of the corresponding slow-speed combination) would present no disadvantages from the constructional or operating points of view.

Another point in connection with the parallel running of polyphase generators, which arises from what has been said above on the subject of phase displacement, is that of the armature reaction of the generators. Clearly this must not be too high, as otherwise the generators will, on the one hand, lack sufficient synchronising power, which it is necessary for them to have, in order that they may operate in parallel with stability, while, on the other hand, the pressure drop on inductive loads would be excessive. But as the armature reaction of a polyphase generator is always evaluated from the pressure drop point of view, this being indeed one of the starting points of the design, all modern generators have a synchronising power far in excess of that necessary to ensure stable parallel running. On the other hand, this must not be pushed too far, that is to say, the pressure drop must not be too small, as if it is, the parallel operation of the generators is again likely to be unstable and would be, in any case, accompanied by large synchronising currents. The only remedy for this will be to insert choking coils in the generator circuits, or to reduce still further the cyclic irregularity of the engines, or to carry out both these things.

Large slow speed polyphase generators should have a full load pressure drop at constant speed and excitation of 5—6 per cent. on a non-inductive load, and 16—18 per cent. on an inductive load of 80 per cent. power factor; better regulation than this is unnecessary and undesirable, if the generators have to operate in parallel.

In the remarks made above on the parallel running of generators, it must be, of course, understood that only one side of the question has been dealt with, and in an elementary manner, namely, that part bearing upon the design of the generator, and the amount of the cyclic irregularity and fly-wheel effect. Naturally other points have to be carefully kept in view, of which the principal is the design of the engine governor, for upon this depends the proper division of the load between the generators, and the tendency to maintain hunting, and sometimes, the tendency to set it up. Such points as these are, however, outside the scope of the present paper.

In practice large polyphase generators driven from slow-speed engines usually work with a cyclic irregularity* of about 1 in 300 for 50 cycle plants, and 1 in 200 for 25 cycle plants. In accordance with what has been said above, it is clear that from the parallel running point of view, the 25 cycle plants will be operating relatively under the better conditions, when these values of cyclic irregularity are taken, and when the comparison is made on the same basis of speed. The reason for this is, that the load on 25 cycle generators invariably consists of rotary converters, which is a load very sensitive to variations in the turning moment of the prime mover. Fifty cycle generators are only employed for lighting and power work, or for the operation of sub-stations containing motor generators; when these latter are synchronous, they are also sensitive to variations in the turning moment, but as they are not in the balanced condition of rotary converters with regard to the load on the two sides, and for other reasons, they are not so liable to hunt as the latter class of machine. So that whereas a phase displacement of about 2° per generator is the most that can be permitted for rotary converter work, 3° per generator is quite permissible for the class of work for which 50 cycle generators are usually designed, which amounts of phase displacement correspond to certain definite values of cyclic irregularity, which can be readily calculated.

The object of the large fly-wheel effects arranged for in the rotating magnet wheels is then to keep the cyclic irregularity within the permissible limits, and as one of the effects of damping currents is to tend to diminish the cyclic irregularity, it is evident that the fly-wheel effect arranged for in the magnet wheel may be smaller if damping currents are permitted. Thus the point to be settled is, shall the cyclic irregularity be limited to the permissible amount by means of the fly-wheel effect of the magnet wheel alone, or shall a lighter magnet wheel be employed, and damping currents be arranged for? In the former case, laminated pole shoes can be used, while in the latter case if solid pole shoes are not used (and sometimes when they are) special dampers must be arranged for, as described hereafter.

Such a point as this must be settled in accordance with the views and experience of the individual constructor, knowing both the engine and the generator in question, but nevertheless there are certain definite features to be kept in mind. If the effects of damping currents are made use of, it is clear that additional losses occur in the generator—the amount by which the generator efficiency is lowered will depend upon the extent of the part played by the damping currents in assisting parallel running. On the other hand, so long as the evenness in the turning moment does not suffer (that is, as long as the cyclic irregularity does not increase) the lighter the magnet wheel the better, for the generator will be easier to synchronise, the engine will be more under the control of the governor (lessening the tendency to hunt), and the design of the generator itself will be more favourable, as already seen. Again, if damping currents can be called into being either in the pole faces or in special dampers, they may be very useful when synchronising very large generators, as they will correct for slight phase differences, and they will certainly be useful should hunting be set up from the governors, as this will be checked before it assumes dangerous proportions.

* This term, which is not a particularly suitable one, means the ratio $\frac{\text{Maximum velocity—Minimum velocity}}{\text{Average velocity}}$ during one revolution; the actual amount varies within narrow limits according to the load on the engine, and the maximum value over the working range of output of the engine must therefore be understood when a figure is put forward for the cyclic irregularity.

The point cannot be settled without reference to the frequency; as shown above, the lower this is, the greater can be the permissible value of cyclic irregularity, a much smaller fly-wheel effect being necessary for the case of a 25-cycle generator than for that of a 50-cycle machine. In the author's opinion, and looking at the question simply from the point of view of the parallel running of the plants under *normal conditions of operation*, 25-cycle steam generators of large size will not require damping as a rule; the pole shoes can be laminated, and the necessary even turning (cyclic irregularity not exceeding $\frac{1}{200}$) can be best attained by the provision of a suitable fly-wheel effect in the magnet wheel. On the other hand, for similar 50-cycle generators, having laminated pole shoes, and operating with a cyclic irregularity not exceeding $\frac{1}{300}$, the fly-wheel effect can generally be supplemented by damping with great advantage. This is partly on account of the service it renders in assisting parallel running, and partly on account of the other advantages (mentioned above) which are of particular service in the case of 50-cycle generators of very large size.

When damping effects are desired in connection with generators having laminated pole shoes, one of the following special arrangements has to be provided. Either the pole shoes must be pierced with a number of holes for the reception of copper bars, which are short circuited at the ends by means of copper strips passing right round the magnet wheel, or else the top cheeks of the field bobbins must be made of copper, or gun-metal, considerably thickened up at the pole horns, and then extended and joined, so as to form bridges of high conductivity round the poles, and between the poles. The former method, which really consists in superposing a regular squirrel cage winding on the pole shoes, was the original one, and is, according to some authorities, far preferable to the latter; such damping coils are shown in fig. 2, and as can be readily imagined, a considerable expenditure in copper and labour is required. On account of this, the merits of this arrangement must certainly be considered in conjunction with its cost. Apart from the consideration mentioned below, the author prefers the second method, considering that the metal is wanted between the poles, and especially all along the pole horns parallel to the shaft. For, as stated previously, the displacement of the magnet wheels (due to the cyclic irregularity), which is superimposed upon the rotation, causes a distortion of the flux in the air gap, shifting this towards the pole-horns, and even into the gap between adjacent pole-horns. On the face of it, it would thus appear that the best place to put the dampers in would be in these positions, where the induced currents in them tend to prevent the shifting of the flux and the changes in velocity. At any rate, experience shows that this arrangement is very effective, and it can be carried out without difficulty at a relatively moderate cost, because all that is necessary is to thicken up the gun-metal upper cheeks of the field coil bobbins, and to extend these cheeks between the poles until they meet, connecting them together at this point, or the bobbins may be left alone, and the pole-shoes bridged across by suitable gun-metal wedges.

But in one respect this arrangement is much inferior to the first one described, in which the dampers consist of a squirrel cage winding. In the latter case, should the field excitation cease (due to an accident, for instance) a breakdown of the plant will be prevented, for the machine will operate as an asynchronous generator or motor, as the case may be. Steam could be shut off from the engine, and with the armature still connected to the bus bars, the machine would run as an asynchronous motor, driving itself and the engine against the friction losses of the combination. Such an induction motor action would not be sufficiently powerful in the case of the second method, and so for those cases where it is desired to eliminate risk of breakdown due to failure of the excitation, the first arrangement suitably carried out would be employed. The dimensions of the bars and short-circuiting rings forming the squirrel cage would be so fixed that the induction motor formed by it, and the armature supplied with current from the bus bars, would be sufficiently powerful to operate the combination at no load, as above described. For instance, referring to the design shown in fig. 2, this generator, without excitation, would operate as an induction motor, developing 400—500 H.P. for as long a time as might be desired; the only way in which the other generating units connected to the bus bars would be affected would be that they would have to furnish the load current formerly provided by the defective generator, and (supposing steam to be shut off from the defective plant) the current taken by the latter in order to run it as an asynchronous motor doing work against the friction of the engine, &c. This current would, of course, be more than that corresponding to the value of horse-power given above, for it would have a large lagging component. Should the defective plant remain under steam, however, it would probably speed up a little, and might even, under certain circumstances, be made to generate current—that is, to take up a portion of the load. In a large power station such a safeguard against total breakdown as this is well worth serious consideration, and thus it might quite well happen that the employment of a squirrel cage damping winding on the generators would have much to recommend it in certain classes of work, quite apart from the effects of this winding on the parallel running of the generators under normal conditions of operation. So that, for instance, with a 25-cycle plant, in which the even turning of the generators was assured on account of correct engine design in combination with sufficient fly-wheel effect in the magnet wheels, it would simply become a question of whether the additional safeguard against total breakdown of the whole station from the cause in question would be worth the additional cost of the elaborate damping arrangement. Such a point as this can only be settled according to circumstances, and the ideas of the engineer laying out the power station.

(To be continued.)

THE OUTSIDE LABOUR QUESTION.

By JAMES WHITCHER.

(Concluded from page 636.)

It need scarcely be said that the moral character of the outside worker, is a matter of deepest importance to his employer, if not to himself. Seeing the inevitable lack of disciplinary influences other than his conscience, it is eminently desirable that it should be of distinctly higher grade than the normal. Unfortunately, it is usually quite the other way with some trades, which we need not specify in particular. Indeed, it behoves employers, being of vital consequence to their credit and profit, to present a stern, unbending front to the many forms of dishonesty that exist to vex them in their outside workers. False timekeeping, as we have seen, is one; drunkenness is another; tool and material thefts another; and so on. Punishment, sure, sharp and severe, is the only just course open to pursue against them. Mercy is quite out of place, and even immoral, here, for the demands of mercy are already too well served by the extreme difficulties of getting a practical grip of the crime. As regards thefts, there are many inveterate tool thieves among the ranks of outside workers; and with well-nigh absolute impunity, they levy persistently on either their master's stores or their fellow workers boxes or bags. Nothing is safe from them; and on quick-changing jobs they can do very well by their thieving. In simple justice to their honest men, and as responsible for introducing the thieves among them, employers ought to keep sharp watch for these propensities, rewarding their detection, and seeing to it that the offender meets his due.

As for the drunkard, it is the duty of every man, employer or employed, to pile up discouragements for him. There is a foolish fashion abroad among employers of condoning and apologising for fits of drunkenness in their workers. Errors and escapades arising from it are overlooked and pardoned, which would be seriously condemned if done in the odour of temperance. It cloaks a multitude of sins in a worker, practically securing for the intemperate a latitude of discipline in which the temperate could not indulge with impunity. This is an altogether wrong and illogical state of things, of course; but there it is; a lamentable confession of the weakness and impotence of employers in the governing of irresponsible men. How often is the remark passed that a man is none the worse worker for being a slave to intemperate habits! A statement which has not the slightes basis in fact, as can be easily and definitely proved by keeping proper records of performance. The bald fact is, a man must be clever above the ordinary if in his responsible moments he has to compensate for a proportion of irresponsible ones, and the after effects of them. Practically a man's working value is depreciated by 2d. or 3d. an hour, for outside work in particular, by a proneness to intemperance; and it would be well if employers awoke generally to this grim reality and acted upon it. No amount of sophistry like the above can disguise the tremendous disability the habitual and occasional drunkard labours under in competition with his temperate colleague. It is a perpetual menace to the character of his work; and no real confidence can be reposed in him.

In dealing with this failing, if it cannot be entirely eliminated from among one's employés, it should still be a rigid rule that it carries a heavy fine in wages. It ought also to be an absolute bar to responsible positions, or even to working alone without effective supervision. Circumstances may tempt departure from these rules sometimes; but if successfully, repentance is like to follow. By boldly and consistently declaring for a reduction of wages as a penalty for drunkenness in their workers, employers, as a body, could make themselves a very potent agency for its suppression, and the benefit will be greatly theirs, as undoubtedly they have to pay the piper for it, under the present tolerant way of regarding it.

Reverting to the wages question, it is only common sense to make the rate paid such as will attract competent men to the trade. To set it so low that only the wastrels and *debris* of other trades are drawn on, is very false economy. Pay for good men, but see that you get good men, and keep them up

to their work. At the same time, grade your men according to the breadth and height of their skill, with pay to correspond, endeavouring always to suit the grade of man to the grade of work. Don't spoil good men by keeping them on indifferent work, when better is available, or by leaving them on the same rate of wages as the common ruck of your hands. Differentiate in unmistakeable manner. There are many halfpennies per hour difference between the *real* money value of men, although trade union rates strive to disguise the fact. The good honest worker earns money for the bad and unworthy. Mitigate this injustice as far as possible by the direct means of wages; don't expect to compensate it by more shadowy benefits. The casual or new hand ought not to be admitted at once to full rates; insist on a term of probation, agreeing, in a case of urgency, to make the rise retrospective, if conceded on trial. Snub the man who talks big; snub him generously. He does it because he thinks it pays, and hopes it will hide his deficiencies. Prove to him it does not; penalise him a halfpenny or two an hour, and don't tolerate him unless he is particularly cheap at his price. Let him understand this, and never take him seriously when he reiterates his demands for a rise. He is, at best, a nuisance and a snare, liable to take you unawares at some unguarded moment, and get entrusted with work beyond his real capacity.

Pay for honesty and uprightness of character in your workers. Pay for it handsomely, for it is getting rare. We have seen plenty of reasons why it should have a real and substantial value in the outside workman. A man may not be brilliant, even he may be comparatively stupid, yet the possession of that rare essence, a conscience, will lift him a long way up the scale of value to you. It is a huge relief, in these days, to be able to trust a man to keep honest time and fill it honestly. Playing policeman is detestable work, but it is a *rôle* forced upon employers by a great bulk of the working classes, whose dominant motives, when laid bare, are seen to carry a very striking resemblance to the motives of criminal classes.

The question of out-money is a very important one in connection with outside labour. It is a heavy tax on employers who have to contract widely abroad for work. Yet, at the same time, it is undoubtedly a legitimate tax. The worker away from home is at a certain extra expense, which should be made up to him, although it may be argued, in some cases, that it is an inevitable condition of the trade he engages in, and, therefore, should not meet with special treatment. Furthermore, it may be said, that if the master did not procure the trade abroad for him, it would be necessary for the workman to go abroad for it himself. It is a matter of equity, but, at the same time, and for the same reason, the amount paid should be the workman's net extra expense, and no more. Usually a man is able to get himself lodged and boarded, and all found, for 14s. per week, which, we find, is a very usual rate. His board at his fixed home would probably cost him 5s., which leaves 9s. as the net extra expense, *i.e.*, 1s. 3d. per day. Single men with no fixed home, may not incur so much or any extra expense; they might justly be put on half the rate. Highly skilled men, such as erectors, leading hands, and foremen should naturally have more, ranging from 1s. 6d. to 2s. 6d. per day; 25 per cent. of the wages represents the average out-money tax, reckoned on a fairly generous scale.

Next as regards travelling time and money, it is well to have fixed rules governing the allowances for these. The time allowed should be the net railway time, plus, say, one hour each end for preparations. The expenses may be the net fares, plus, say, 1s. each end and changing point for luggage charges. These figures appear fair and proper limits from both sides of the question. The added allowances of time and expenses only to apply in the case of prolonged absence requiring full equipments of personal luggage and tools. On a long journey a man may be put to other expenses; but he should take into consideration that he is being paid for a lot of unproductive time.

Speaking of tools, it is highly desirable that all outside workers should provide themselves with full equipments of the necessary hand tools belonging to their trade. In some trades it is an understood thing, and no reputable member of them will be without good tools kept in fine order. In others there is a tendency to lean on the employer for these necessaries; and in such we invariably find great tool wastes and losses, and much loss of time and bad work for want of them. It is the barest wisdom in an employer to insist that each of his men shall keep a full equipment of hand tools, and have them ready to hand on a job and in proper order. Any man found deficient should either be suspended or supplied with tools at the expense of his wages. No borrowing from each other should be countenanced, as it is unfair to the careful provident workman, who can scarcely refuse when asked, and it means much waste of time. Arrangements should likewise be made by which each apprentice is provided as early as possible in his career with a sufficient kit of tools.

As regards the heavier tools, which the employer has necessarily to find, it is wise to enforce a responsibility for their custody and good treatment upon all workers using them. Such plant is very apt to go astray, or be allowed to take care of itself, and it is not always convenient to have someone in special charge of it. Therefore it is policy to visit neglect with severity on all concerned. The same applies to the preservation and proper usage of materials. Yet with all precautions good storekeeping is still an indispensable factor of a business conducted on sound lines. The storekeeper is too often a despised unit, and his work held in indifference; yet his position is one of much difficulty, and if he fill it well his wage is truly earned, in spite of appearances arguing that he has nothing to do for it.

The apprentice question is another that is full of perplexities. There is a very mean tendency, even among fair-minded workmen, to deny employers any benefit or profit from the employment of them. On outside work especially this antagonism can be freely and effectively indulged in; so that apprentices are encouraged in idleness, or even have it enforced upon them. The habits thus acquired stick to them, and that is largely why there is so much just ground for complaint against the regular outside worker. And, helped by the brevity of apprenticeships now in vogue, it destroys the youth's chance of really learning his trade, and the "skilled" workman, when he thinks himself "finished," is in sober truth little better than a labourer. There is no honesty in this antagonism, and it ought not to exist. The men who act up to it may even be parents themselves, and surely it is some consideration to them to get their sons the opportunity of learning trades, and of learning them well. It is of substantial value this schooling for a life's work, but a youth is well able to pay for it by his own efforts if allowed and assisted to work his best. If this is not to be, it is hardly to be expected that an employer will experiment with youths, when the work they do is made to cost as much as though done by men. He must withdraw the opportunity to learn, or else inflict heavy premiums.

The premium system is far from satisfactory, for several reasons. It excludes good raw material; it gives boys of some natures an inflated idea of their relations to their masters, and it appears to give them a prescriptive right to be taught, whereas the actual consideration in practice is the opportunity to learn—a very different thing. On the other hand, it is of some usefulness in preserving the apprenticeship in the earlier stages, but in the later stages when its binding powers would be more valuable in the interests of the employer, they have ceased to exist. A better system, with the object of guarding against the breaking of apprenticeship, would be a returnable premium, paid back only in case of completion of the full term, and satisfactory conduct and work throughout the term. Or better still, perhaps, a system of deferred pay, paid over at the end of term on the same conditions.

There are some trades—electric wiring for instance—in which a veneer of skill is quickly obtained. And as, in the busy season, there are always improvident employers in desperate hurry with belated jobs, chances come often to the learners of stepping unquestioned into the responsibilities of fully skilled hands. Of course, they never go back to their schooling again; that must come in the day's work thereafter. Thus is lowered the average standard of skill, until it is a puzzle at times to find out where the skill comes in at all. This applies in the higher ranks as well. It is an ill state of affairs from all points of view; and to remedy it, it is clear that the present apprenticeship system needs radical alteration.

Obviously it is to employers' interests to encourage learners. To keep the ranks of workers well and ably filled should be one of the first aims of employership. Restriction of the supply ought not to originate with the masters, but rather with the men. Apart from this, it is often the case that men on a job have to work in pairs, which means generally that a man is doing what a lad could do as well. Better to have a surplus of idle boys about than to allow this. The imposition of premiums is undoubtedly a great deterrent, and their entire abolition seems only wise. Again, why take boy apprentices only? Why should not labourers, or the men who find too late that they have made a mistake in their life's work, be allowed and even induced to apprentice themselves? A system of deferred pay would meet their case admirably, and it would secure splendid recruits to a trade—earnest-minded men who have found themselves, as contrasted with the featherheads, who, led along an easy way from their youth, never get really out of leading strings. It were idle nonsense to argue that a grown man, when he will, cannot learn better and more quickly and thoroughly than a boy. It may be necessary to pay him at a level instead of a progressive rate throughout the term; but to such a man the prospect of a certificate of skill at the end will be even a stronger anchor to his school than the deferred pay. Innovations like these must, of course, be carried out in no half-hearted manner. They must be fully considered, proper agreements drawn up, and rules and conditions set forth in black and white for the avoidance of all misunderstandings.

A word of disgust here for the practice of taking heavy premiums for making engineers of pupils or apprentices, and teaching them only a section of a trade. It is a fraud, and it launches fleets of living frauds, disgracing the profession. One cannot turn out an engineer except by giving him prolific terms of experience in all the aspects of his particular section of the profession—the workshop aspect, the designing aspect, the erecting aspect, the commercial aspect, and so on. Yet many who take these premiums have no legitimate means of providing these varied experiences. Mere attendance on a switchboard, an engine, or a dynamo, does not qualify for engineership, nor wiring, or winding, or testing. Resourcefulness in all things appertaining to his work is *the* quality that makes the engineer. To some it is almost natural, but to most it has to come through varied and exacting toil and observation.

In concluding these too lengthy remarks, I—lapsing into the *ego*—would earnestly protest that they are not written for the belittling or belabouring of the *honest* worker. On the contrary, I feel very kindly towards him, and wish him well in all ways, and higher and higher wages, until the earning power of his capital comes into fairer equality with that of money.

THE ECONOMY OF ISOLATED ELECTRIC PLANTS.

II.

In a recent number (p. 250) we discussed an article which appeared in the January issue of the *Engineering Magazine*, from the pen of I. D. Parsons, bearing the above title. In the article referred to the cost of producing electricity in an isolated installation was compared with the prices charged by public supply authorities in the same district. The class of consumers then dealt with were business houses, such as offices, department stores and loft buildings, and it was shown that, generally speaking, it was cheaper to generate than to buy electricity. In the February issue of the same journal a second article deals with a different class of buildings, viz., those used for residential purposes, including hotels, clubs, and apartment houses.

Great difficulty was again experienced in obtaining accurate figures of costs, or, in fact, figures of any kind, as records are very rarely kept in such establishments. The load factor in apartment houses is not a very favourable one for the economical running of an electric light plant, if an all-day service is given. Again, it is not usual in the design of such buildings to make any provision for generating plant, and it is expensive, often impossible, to add this later.

The first analysis of costs given is of an apartment house, of a type which includes more than half the better class houses of this kind in New York. It is a 7-storey building, having a ground plan area of 90 ft. × 75 ft. There are two generators having outputs of 15 and 30 KW. respectively at 115 volts. Between 7 a.m. and 5 p.m. the average load is only about 25 amperes, or less than 3 KW. The smaller plant is therefore run at about one-sixth of its full output during this time. In the building is a 15 H.P. elevator, so when this is in use the small generator is momentarily fully loaded. At night the lighting load rises to a maximum of 200 amperes, or 23 KW.

The larger plant is then run for lighting, and the smaller for the elevator, a system the author (Mr. Parsons) recommends in order to avoid blinking the lights. It is seen therefore that both plants are run at considerably less than their full loads, viz., the large plant at 70 per cent., and the small one only loaded intermittently. The plant is shut down at midnight till 7 a.m. The load factor of the lighting load is given as 0·43, and the average load on generators as 0·48.

The annual output is 82,130 units at a total cost of about 3·2d. per unit. This figure includes interest and depreciation on the same basis as before, and also includes steam for heating the buildings. As the cost of the latter is known for similar sized buildings, a comparison with central station rates is possible, and the annual saving is shown to be £700 in favour of the isolated plant.

On the other hand, a similar sized building shows a loss of £20 on the six winter months. As a full year's figures could not be obtained, a true comparison cannot be made, as the steam heating plays a very important part in this case. In the three mid-winter months the figures show a saving on central station rates, but there is a loss on the other three. The loss would be greater in summer, as the lighting would be less, nothing could be charged to heating, and the standing charges would be the same. The approximate annual loss would be £140.

This is almost entirely accounted for by the bad arrangement of the plant. The generators are not properly proportioned to the load, so that the all-day efficiency of the plant averages about 39 per cent.

It is really a case of bad engineering. Accumulators in either of the above cases would have improved matters, and would have permitted of a 24 hours' supply.

An hotel load is quite different, and is very favourable to an isolated plant installation. Steam plant is nearly always required in a large hotel for laundry and heating purposes, so that the extra labour expense for electrical plant is in some cases *nil*. From the data given it would appear that hotel conditions are more favourable to the isolated plant than in any other class of buildings.

The most favourable instance given is of an hotel measuring in ground plan 100 ft. × 200 ft. Only the first and second floors are lighted. The only extra labour required is one fireman. The following are the particulars in brief:—

Two 66-KW. generators, 118 volts.
Hor. tub. boilers, 90 lbs. pressure.
Average load on generators, 0·5.
Total output in 10 months, 115,000 units.
Cost per unit 0·95d.
Total cost for 10 months, £460 = say, £550 per annum.
" " at central station rate, £1,200 = £1,440 per annum.
These figures are for electricity only, and do not include the cost of heating.

In another hotel of eight stories, 60 × 160 ft. in plan, it was found during a month when the dynamo was shut down that the electric light bill from the central station was 25 per cent. greater than the cost of operating the machine.

Clubs have not such a good load factor as hotels; there is a very small morning load, and some clubs, therefore, use the supply current during that part of the day. In a small club using a 20-KW. coupled plant from 4 p.m. to 1 a.m., running at about three-eighths load on the average and using steam for heating, the saving is about one-third as compared with central station rates. In a larger club, having three 130-KW. dynamos, generating a total of about 94,000 units per annum, the saving is over £800 per annum

which represents an economy of over 40 per cent. Steam is used for heating. Owing to the use of elevators one generator runs inefficiently for the greater portion of the day. Here again accumulators would probably have reduced the costs.

The data of the 17 buildings given, show a decided advantage in favour of the isolated plant over central station rates, and curiously, the smaller buildings show the greater percentage gain.

The author finally discusses at length the factors which influence economy, among which are the correct arrangement of plant to secure a high load factor, together with low costs of interest and depreciation; the shape of the load diagram; the keeping of daily records; the character of the engineer-in-charge; the temperature of the engine room; coal storage capacity; and the use of accumulators. This by no means exhausts the subject of isolated plant economy; such instances as collieries, docks, factories, isolated manufacturing works, &c., are not touched upon. On a future occasion, therefore, we may take up the subject from these points of view.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

9,150. "Improvements in clock-controlled mechanism for turning on gas, electric current, water and the like at predetermined times." S. W. North. April 21st.

9,208. "Improvements in switch and fuseboards." A. W. Y. D. Chapman. April 21st.

9,229. "Improvements in audible electric telegraphy." R. Oxlade and W. J. W. Richardson. April 21st. (Complete.)

9,231. "Apparatus for counting telephonic conversations." J. H. Meyer. April 21st.

9,256. "Improvements in and relating to pendant glass shades for electric or gas lights and other purposes." C. M. Heron. April 22nd.

9,264. "Improvements in the construction of electric lampholders." W. Allman. April 22nd.

9,265. "An accessible water-tight and insulating coupling for electric cables." A. J. Morgan. April 22nd.

9,267. "An improved dynamo-electric machine or motor." A. H. Finlay. April 22nd.

9,278. "Improvements in incandescent electric lamps." M. Hayashi. April 22nd.

9,325. "Improvements in insulating tubes for the windings of electric machines such as motors and the like, and in the process of making same." M. Meirowsky. April 22nd. (Complete.)

9,352. "Improvements in the method of actuating key switches enclosed in cases." E. Lawley-Pinching and L. Milne. April 23rd.

9,367. "Improvements in trolley-poles for electric tram and other cars." S. R. Jackson. April 23rd.

9,371. "Improvements in cycle and motor or motor-car ways with or without the formation of space for sheltering electric wires or chambers for rifle firing practice." J. C. Sellars. April 23rd.

9,380. "Improved fuse head for electric blasting." F. Render. April 23rd. (Complete.)

9,397. "Improvements in dynamo-electric machines." H. Chitty. April 23rd.

9,419. "Apparatus for sounding and recording code signals for electric fire alarm and other purposes." G. B. Bowell and The Pearson Fire Alarm System, Limited. April 23rd.

9,423. "An improved flexible electrical conductor from any point of which a current may be taken." H. Bevis. April 23rd.

9,433. "Improvements in or relating to silver plating and gilding processes." J. Schiele. April 23rd. (Complete.)

9,439. "Improvements relating to protecting apparatus for controlling the consumption of current." F. W. Schnieder and A. Strauss-Collin. April 23rd.

9,441. "Improvements in electro-magnetic traction for railways and the like." H. H. Lake. (A. Pacinotti, Italy.) April 23rd.

9,488. "New or improved mountings or fittings for incandescent electric lamps for illuminating shop windows or for outlining buildings or other illuminations or other analogous purposes." A. W. Beuttell. April 24th.

9,503. "Improvements in incandescent lamp attachments." G. D. Pogue. April 24th. (Date applied for under Patents Act, 1901, April 29th, 1901, being date of application in United States.) (Complete.)

9,504. "Improvements in electric lamp sockets." M. Norden. April 24th. (Complete.)

9,529. "Improvements in terminals and binding screws for electric batteries and connections." W. R. Edwards. April 24th.

9,531. "Improvements in electricity maximum demand meters." G. Byng and E. Sayer. April 24th.

9,592. "Improvements in or relating to electrical fuse boxes." E. F. Moy, P. H. Bastie, and E. F. Moy, Limited. April 25th.

9,669. "Improved apparatus for starting alternating current motors." T. H. Churton. April 26th.

9,704. "Improvements in and relating to electric switches and wall plugs and bases for the same." A. Vandam and T. H. Marsh. April 26th. (Complete.)

9,721. "A new or improved high tension electric condenser." A. Vosmaer and A. Lebret. April 26th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

4,926. "Improvements in automatic time switches." A. J. Howard. Dated March 15th, 1900. A clock dial is fitted with adjustable arms adapted at predetermined times to engage pins connected to a weighted lever. When this lever is thrown over, it tilts the balanced switch lever and makes or breaks contact. 1 claim.

4,934. "Improvements in electric current feeding device for electric tramcars and the like." J. W. Ehlers. Dated March 15th, 1900. Relates to means for feeding electric current to motor tramcars and the like, and comprises a series of elastically-mounted conductors, which are successively depressed by the contact or take-up wheel of the car into contact with the main conductor lodged beneath in the rail. The sectional conductors are supported by an elastic insulator, and have lugs for making contact with the main conductor when they are depressed by the contact wheel. The latter may be made in two parts, which grip the insulated ring. In the fishplate joints beneath the rails suitable insulation may be provided between the plates and the rails, round the bolts, and between the rail ends. 4 claims.

5,003. "Means for automatically receiving or reinforcing exhausted pulsations upon a telephone line." M. C. Mengis. Dated March 16th, 1900. Relates to repeating arrangements for use in telephone systems. The two line sections are connected through solenoids to the insulated portions of a pivoted arm. This arm, which is connected to the solenoid cores, is controlled by a spring, and the ends play between contacts; the normal contacts are connected to the repeater, which the others are connected together to enable high-tension calling currents to avoid the repeater. The repeater consists of two, preferably, double-wound magneto telephones, having microphones as diaphragms. The microphones are connected with the primaries of the corresponding induction coils, and the magnetos are cross-connected to the secondaries. The magnetos may be single wound, when the earth connections shown are omitted. 3 claims.

5,016. "Improvements in power for diaphragm for electrolytic apparatus." T. J. Holland and A. P. Laurie. Dated March 16th, 1900. Diaphragms are formed of a non-metallic woven fabric coated with a thin layer of an insoluble silicate and supported by a cement or equivalent framework. The tank having cathodes is provided with one or more earthenware or cement cells formed of top, bottom, two sides, and two ends, and enclosing the anodes. The sides of the cells have open panels, across which is placed the fabric, such as asbestos cloth or the like, coated with and secured to the frame by a thin layer of cement. 1 claim.

5,046. "Improvements in electricity meters." A. Wright and Reason Manufacturing Company. Dated March 16th, 1900. Mercury voltameters are provided with registering mechanism operating by means of gravity. In one arrangement a mercury anode is contained in a small glass dish attached to a vertical glass tube, the upper end of which carries a pointer near a stationary scale, and which is suspended by a helical spring. Electric connection is made with the anode by a platinum wire in the glass tube. The anode is suspended in a vessel containing the electrolyte, and a mercury cathode at the bottom. As current passes, the anode becomes lighter, and the pointer rises. This arrangement may be used with the movable part connected as cathode, the cathode surface being provided by a conical coil of platinum wire or a porous carbon block; the anode is mercury in an annular trough, above the cathode. In a modification, the glass tube and dish may be stationary, the vessel containing the electrolyte and lower electrode, being suspended by a spring. In other constructions, the anode and cathode are mercury contained in recesses at the ends of an inclined tubular vessel filled with the electrolyte. The anode may be fed with mercury from a bulb as described in Specification No. 2,222, A.D. 1900. The vessel is supported by a clip on a pivot, its inclination changing as mercury is transferred from the anode to the cathode. The vessel may be connected with a spring by a thread passed round a pulley on the axle of a pointer, so that this moves along a stationary scale as the vessel turns. Or the clip may carry a suspended receptacle to receive a chain balancing the mercury transferred, the chain being supplied by a spring or other motor, when this is released by an arm of the clip; the motor also drives counting wheels. 7 claims.

5,050. "Improvements in asynchronous rotary converters and other dynamo-electric machines." W. P. Thompson. Dated March 16th, 1900. Relates to asynchronous rotary converters and like machines, the stator being supplied from two entirely independent sources of energy. 6 claims.

5,088. "Bonding for iron or steel electrical conductors." R. Thomson. Dated March 17th, 1900. Electric conductors of iron or steel, such as rails on electric railways and tramways, are bonded by cleaning the surfaces in contact on the fish-plates and rails, &c., and covering them with a metallic paste. 2 claims.

5,136. "Improvements in intercommunication telephone systems." M. Byng and F. G. Bell. Dated March 17th, 1900. Direct-call systems for intercommunication between the various members are arranged with additional separate metallic circuits between the subscribers, such circuits being connected to an auxiliary double-contact switch. 4 claims.

5,137. "Improvements connected with incandescent electric lamps." W. C. Gale. Dated March 17th, 1900. A lamp is provided with a central conical reflector made of porcelain or earthenware, either hollow or solid, and either white, glazed, or coated with silver or platinum, which may be glazed, or provided with a glass cover; the reflecting material may be applied to such cover. 2 claims.

5,167. "Improvements relating to alternating current electric motors." J. and W. Yates and J. B. Bent. Dated March 19th, 1900. Motors, alternating current:—An alternating-current motor for driving ventilating fans, &c., is constructed without any rubbing contacts. The stationary field magnet is built up of laminæ provided with perforations, serrations, teeth, or the like, in which a number of wires constituting the windings are laid simultaneously in the form of a cable, the ends of the wires being subsequently connected together in such a manner that all the windings are in series. For this purpose the cable ends are led to a board provided with terminals. 3 claims.

5,178. "Improved means for connecting electric cables." C. A. Day. Dated March 19th, 1900. Relates to means for connecting lead or like covered cables. The conductors are connected by a sleeve or like joint and the space filled in with insulating material. A lead sleeve is then slipped over the joint, the edges first being coated or amalgamated with mercury as described in Specifications Nos. 5,176 and 5,177, A.D. 1900. A practically homogeneous joint is then formed by the application of heat and pressure. In a modified joint a ring is fitted between the covering and insulation. 5 claims.

5,183. "Improvements in electric locks." H. E. Newton. Dated July 19th, 1900. Relates (*a*) to controllers for rendering bolt-actuating mechanism operative or inoperative; (*b*) to circuit-closing devices which complete the electric circuit only when the volt mechanism is actuated; (*c*) to key-operated circuit-closing devices; and (*d*) to protection plates for use with locks. 47 claims.

5,216. "Improved manufacture of filaments for electric lamps." A. J. Boult. Dated March 19th, 1900. Filaments of high resistance for use in exhausted bulbs are made of boron or silicon, or both together, optionally containing some carbon. In one method, boron in impalpable powder is mixed with a binding material containing carbon, boron or silicon, such as coal tar dissolved in benzine, and squirted to form filaments, which are heated under powdered charcoal and titanium in an electric or other furnace. They are flashed in vapour or carbon, boron or silicon compounds, such as boron hydride or ethyl boron, and may be coated with a rare oxide by electrolysis or otherwise. In another method of making a filament, a fine platinum wire is heated electrically in vapour of a boron compound, and afterwards to a higher temperature to volatilise the platinum. 8 claims.